THE

ELECTRICAL REVIEW.

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THE

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CONCURRENT ELECTRIC LIGHTING POWERS.

HOLDERS of provisional orders under the Electric Lighting Act are passing through a very anxious time. From all parts of London and of the provinces we hear of notices having been received by the local authorities of the intention on the part of companies, new and old, to apply for concurrent powers over their districts next November.

The notice round which will, perhaps, centre the most interest is that given by the Charing Cross and Strand Company to the Corporation of the City of London. The application of the company is contained in a letter to the clerk of the Streets Committee of the Public Health Department of the Corporation, and sets forth at some length the grounds of its application, and finally states that "Section 1 of the Electric Lighting Act, 1888, expressly provides for and encourages competition, even with a local authority."

This same Section 1 has been much in evidence lately, both in the House of Commons and in the committee rooms, and the important sentence with which it closes has been often quoted :—

> The grant of authority to any undertakers to supply electricity within any area, whether granted by license or by means of a provisional order, shall not in any way hinder or restrict the granting of a license or provisional order to the local authority, or to any other company or person within the same area.

We must say that we fail to discover in this clause grounds for the statement made by the Charing Cross and Strand Company that there is an *express encouragement* of competition.

It is true that the ordinary layman, anxious to make himself master of the Act, finds it difficult, in studying this clause, to define its precise meaning.

On the first perusal he may pardonably come to the conclusion that the words "*any undertakers*" cannot possibly include the *local authority* of the district, for, manifestly, if a provisional order for electric lighting were already possessed by the local authority, there would be no sense in stating that that possession did not hinder the granting of a provisional order within the same area to such local authority. Following the clause to its conclusion the inquirer would certainly judge that "any undertakers" must be interpreted as "any company," as the clause goes on to refer to any *other* company.

On reference, however, to Section 2 of the Act of 1882 he will learn that

> The provisions of this Act shall apply to every local authority, company, or person who may by this Act, or any license or provisional order granted under this Act, or by any special Act to be hereafter passed, be authorised to supply electricity within any area (in this Act *referred to as "the undertakers"*).

whereby it appears that the words, "any undertakers," must embrace both companies and local authorities, thereby making nonsense of the much quoted clause.

Parliamentary lawyers have, however, had no hesitation in translating the clause to mean that the possession of a provisional order, whether by a local authority or a company, shall not in itself be any bar to the grant of concurrent powers to a company or to a local authority.

This provision has always seemed to us a wise one. In

the absence of such a clause, the "undertakers" would have been justified in considering themselves the possessors of a monopoly, and would have cared, as the City of London Company apparently has cared, very little for the interests of the consumers, and have exacted, as that company has done, its full maximum price.

We do not overlook the fact that the provisional orders granted by the Board of Trade reserve to that body the power of revocation of the order in whole or in part, in the event of the neglect of the undertakers faithfully to fulfil their obligations thereunder; but revocation is a very serious measure, and one that the Board of Trade would only enforce under strong provocation. Indeed, only in cases where, after the expiry of some years, not a single step has been taken to put the order in force, has revocation ever been enforced by the Board of Trade.

Manifestly an undertaker can much more easily be kept on the path of good behaviour by the near possibility of competition than by the remote one of revocation. Hence the excellent moral effect of the closing words of Section 1 set out above.

That, in the opinion of the Board of Trade, the clause should operate in its moral effect, rather than be put into practice, has been proved by the persistent refusal in that department, in all except one solitary case (applying to a district in the heart of the metropolis), to grant powers to a second "undertaker" where a provisional order was already in operation.

Those whose interests lead them to advocate unrestricted competition point triumphantly to the fact that in some 14 parishes in the metropolis the Board of Trade have granted competing powers to two companies. They, however, omit to state that these competing powers were, with one or two special exceptions, all granted at one and the same time in consequence of the rush made by companies for the choicest parts of the metropolis in the session following the passage of the amending Act of 1888.

The only similar case that occurred outside London was, we believe, in Newcastle-upon-Tyne, where the two undertakers agreed not to compete, but to divide the city into two equal portions, each undertaking operating solely within its own territory.

Our point is, that where an undertaker has been in possession, faithfully carrying out the obligations of the order, the Board of Trade has never granted concurrent powers to a second undertaker.

As a result of this sensible interpretation of Section 1 of the Act of 1888 by the Board of Trade, local authorities and capitalists alike have seen a security for capital in undertakings under the Act sufficient to induce investments aggregating some fourteen millions sterling during the past 10 years, and to this large investment is due the present very flourishing state of the electrical industry. In our opinion no more serious blow could be given to that industry than the withdrawal of the vital principle of security for capital. In this country, where we pride ourselves upon security for capital and fixity of tenure as the basis of our commercial prosperity, it will hardly be credited that an attempt is being made in the present Parliament wantonly to destroy the whole basis of our industry, but such, we regret to say, is the case, for the recent decision of the Select Committee of the House of Lords in the case of the General Power Distributing Bill, gives to a company the right of competitive supply of electrical energy in districts already covered by provisional orders granted to local authorities.

The district allotted by the Bill to the company covers an area of 2,000 square miles, and includes the cities of Sheffield and Nottingham and the towns of Lincoln, Chesterfield, Rotherham, Doncaster, &c., &c. Some of the corporations have already invested, and the others have entered into obligations to invest, a very large amount of capital in carrying out the provisional orders granted to them by the Board of Trade, and they have done so on the faith of a continuance of the interpretation of Section 1 of the Act hitherto given by the Board of Trade.

The case is very well put by Mr. Robert Hammond in a letter which appeared in the *Times* of Monday last. During the past 20 years Mr. Hammond has been in touch with local authorities on the subject of electric lighting, and no one in the country can perhaps speak more authoritatively than he as to the view that local authorities take of the investment of capital in electric lighting undertakings.

It will be remembered that a fortnight ago Mr. Braithwaite, jun., wrote to the *Times* and other papers urging that where a company had been faithfully fulfilling its obligations it should not be disturbed by the opposition of a local authority, and we await with some anxiety the decision of the House of Commons Committee in reference to the pending cases of Bermondsey and Marylebone.

Mr. Hammond takes up the opposite tale, and we quote from his letter as follows:—

> It has been my province on many recent occasions to act for local authorities applying for powers, and I am able to fully confirm what Mr. Braithwaite has said in reference to the rule which has hitherto prevailed at the Board of Trade of not permitting a local authority to obtain concurrent powers unless saddled with the obligation of purchasing the existing undertaking, and though it has been my duty on behalf of the local authority to endeavour to make the best terms possible with the company, I am prepared to fully admit the justice of the plea formulated by Mr. Braithwaite.
>
> My object in addressing you to-day, however, is to go a step further, and to point out that the fixity of tenure subject to good behaviour, which, in the opinion of capitalists, should prevail in the case of electric lighting companies, should also obtain in those cases where local authorities have laid down electric lighting works—that is to say, while admitting the justice of the plea that companies, holding statutory rights and satisfactorily carrying their obligations out, should not be competed with by local authorities, so local authorities, holding statutory rights and satisfactorily fulfilling their obligations, should not be competed with by companies. Yet, to my great surprise, I find many, who give their complete adhesion to the former proposition, are inclined to deny the soundness of the latter. Surely if capital provided by the ordinary investor is to be protected from undue competition, so this protection should also be extended to the capital provided by the community in its collective capacity.
>
> To take the case of the city of Sheffield. It has recently, at an outlay of a quarter of a million sterling, acquired the works of the Sheffield Electric Light Company, believing that the rule which has prevailed hitherto of leaving an undertaking free from competition, while it satisfactorily carried out its work, would not be annulled. Now the ratepayers of Sheffield, after having made this investment, find themselves by the decision of the Select Committee face to face with a competitor.
>
> I plead for the same protection to the property of local authorities as that which your recent correspondent urged should be given to investing companies.

The amount invested by local authorities up to the present time in electric lighting undertakings has reached a sum of close upon six millions sterling, but we venture to predict that until this pernicious decision of the House of Lords' Committee be reversed, every local authority in the United Kingdom will hesitate to embark new capital in a business which is subject to the contingency of competition with an irresponsible company, whose main object in invading their territory would possibly be to force the local authority to buy them out.

The juncture is a serious one; but whatever the decision may be, there is one good feature in connection with it. The local authorities who find themselves by the decision of the House of Lords' Committee so strenuously stirred to oppose the grant of concurrent powers to companies, have received an object lesson which will cause them to acknowledge the injustice of a local authority applying for concurrent powers over a district of a company where that company is faithfully fulfilling the obligations of its provisional order.

Our readers are aware that the Board of Trade have, in departure from the custom that has guided them hitherto, granted to the Vestry of Marylebone and to the Vestry of Bermondsey a provisional order, in spite of there being in the one case the Metropolitan Company and in the other case the London Electric Company already holding powers in their districts. These provisional orders will, in the course of the next day or two, come before a Select Committee of the House of Commons, and we trust that the grant of the orders will be refused, unless it be conclusively proved that the companies at present holding the provisional orders have not faithfully fulfilled their obligations under these orders. In that case, of course, the plea for concurrent powers would be a strong one. In our opinion, it is the only plea that should ever be urged for the enforcement of Section 1 of the Act of 1888.

THE ELECTRIC LIGHTING OF WINCHESTER.

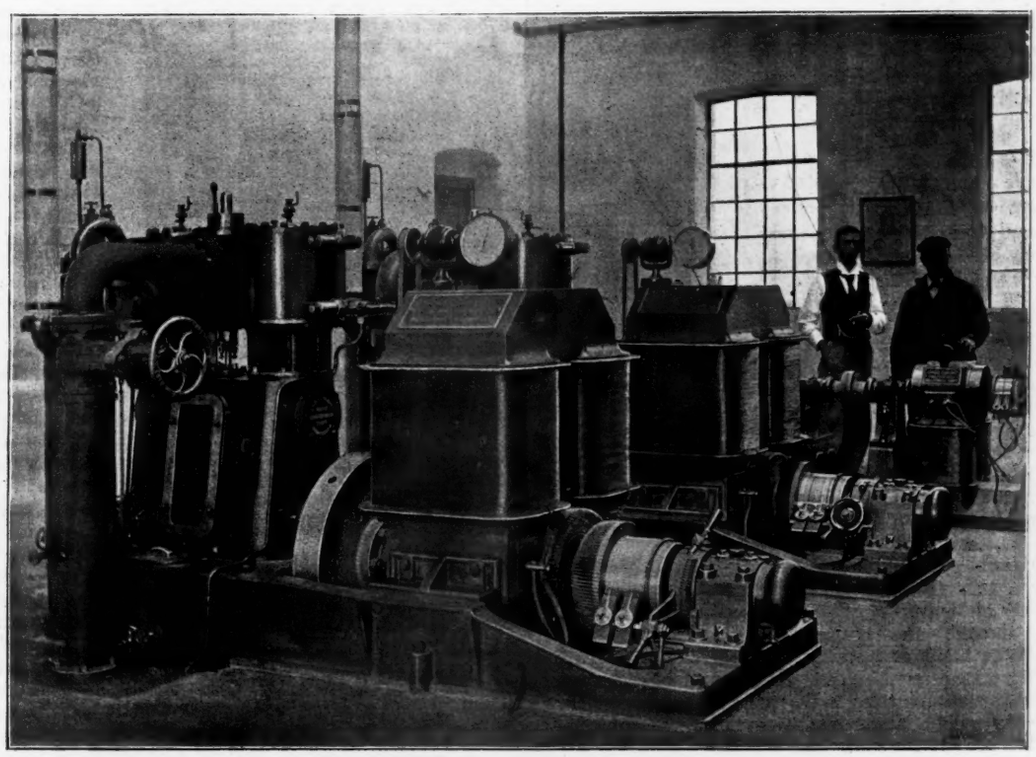
The works of the Winchester Electric Light and Power Company, Limited, were opened by the Mayoress (Miss Bowker) on Thursday last week. The ceremony was performed before a distinguished company, which included the Mayor (Mr. Alfred Bowker), the Bishop of Guildford, Canon Warburton, Alderman T. F. Kirby, W. Shenton, W. T. Warren, T. Stopher, Councillors G. Wright, W. H. Jacob, C. H. Goodbody, J. Marks. W. D. Gibb, B. D. Cancellor, A. Tebbutt, A. R. Dyer, F. S. Morgan, C. S. Wooldridge, R. J. Harris, P. W. Snelling, and H. Easther, General Oldfield, General Montgomery, Col. Hamilton (Ryde), Captain Clayton Mitchell, H. C. Damant (Cowes), and many others, including Mr. F. E. Gripper, managing director of Edmundsons' Electricity Corporation, J. C. Wigham, Messrs. Edmundsons' engineer, L. A. Hands, resident engineer to the Salisbury Electric Lighting Company, H. A. Warburton (secretary and engineer), F. G. Poulton (assistant engineer), and W. T. Pressland.

A capital lunch was subsequently partaken of at the Royal Hotel, a charming old hostelry with associations dating back for centuries, where, by the way, we hope to see the electric light in full swing before many weeks have passed by. Alderman T. F. Kirby presided, and immediately supporting him were the Mayor and Mayoress, Canon Warburton, and most of the gentlemen present at the opening ceremony.

In reply to the toast of "The Mayor and Corporation of Winchester," the Mayor, who was cordially greeted, observed that such an occasion must be a memorable one in the city, and it was very gratifying to him to be present as Mayor. Some people used to say that Winchester was asleep, but he thought they were getting into very enlightened days indeed. If he might deviate a little he would venture to take a liberty himself and propose "Success and Prosperity to the Winchester Electric Supply and Power Corporation." The Winchester Corporation, he was sure, wished all progress and prosperity to commercial undertakings in the city, and they, therefore, wished especial prosperity to the company which had just started its work.

Mr. Gripper (Edmundsons' Electricity Corporation), acknowledged the toast, and referred to the way the company came into being, the action of the Corporation in the matter, and the admirable way they were supported by the gentlemen who acted as directors of the company. They now saw before them about 3,000 lights to start with. As regarded the cost, that was a thing they would soon find out for themselves; but it was not an extravagant light at all, and the present company were adopting a sliding scale, in which the more they used the less they would pay in proportion. He hoped as years went on the Winchester Company would justify the enthusiasm with which they had received the toast.

Mr. Wigham also made a few remarks. He expressed his indebtedness for the courtesy with which the company had been treated whilst the cables were being laid, and said that the mere fact that between 2,000 and 3,000 lamps were being connected every day all over the country showed that the electric light was no luxury.



General View of Engines and Dynamos.

Mr. Poulton, we believe, was a premium pupil with Messrs. Belliss, and went to Winchester in the first place to erect their part of the plant, and with Mr. Warburton has since supervised most of the station work.

Previous to the opening ceremony the visitors were shown over the works by Mr. J. C. Wigham, who explained the details of the machinery.

After making a tour of the works, the party again assembled in the engine room, where the Mayoress performed the ceremony of switching on the light.

Alderman T. F. Kirby thanked her for performing the duties imposed upon her, and on behalf of the company he asked her to accept the special switch with which she had just turned on the electric light.

The Mayor was heartily received on stepping forward to acknowledge the gift. He said it had given both the Mayoress and himself great pleasure to be present on such an interesting occasion. He expressed the opinion that it was quite time that they should have the electric light in Winchester.

The City was lighted by oil previous to 1895, when the Council secured a provisional order. Obtaining, however, a

low tender from the gas company for public lighting, it was decided not to proceed with the order. Then, in the autumn of 1896, Messrs. Edmundsons' Electricity Corporation made the Council an offer for a transfer of the order, giving them the option of purchasing the undertaking under easy conditions. The necessary formal proceedings occupied a long time, and work was not actually started till last autumn.

The whole of the works have been designed and erected by Messrs. Edmundsons' Electricity Corporation, Limited, Mr. H. N. Warburton acting as their resident engineer.

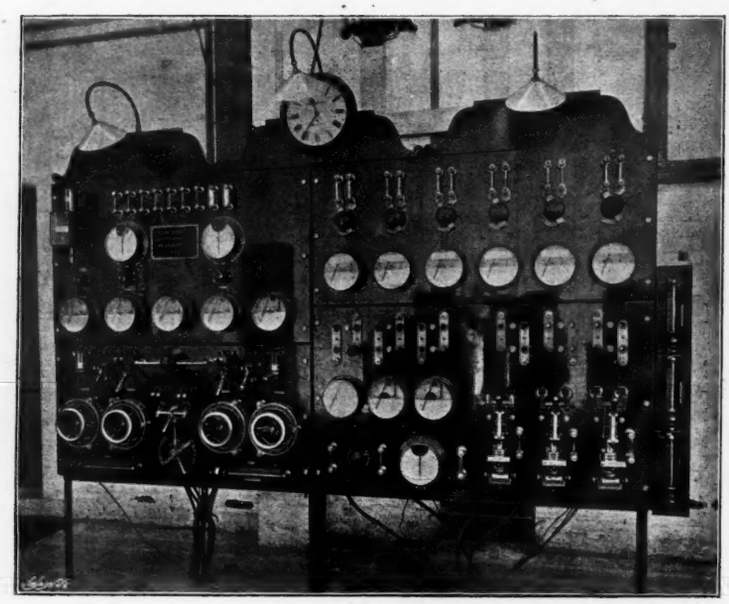
The general scheme is based on the assumption that 6,000 8-C.P. lamps may be expected to be connected in the area in which the mains are laid within a year or so.

A site for the station was obtained on the north side of the town, on a piece of ground formerly occupied by the buildings of the Abbey of Hyde, in the church of which were buried several of the Saxon kings, notably, Alfred the Great. The site is not far from the railway station, and there is a stream running through the premises, which is intended to be used for condensing purposes when the station grows bigger.

The buildings were erected under the supervision of Thomas Stopher, Esq., the architect in Winchester, by Mr. J. Thompson, of Peterborough, who, at the time the contract was settled, was engaged in the repair of the cathedral roof.

In the boiler house there are at present erected two Babcock & Wilcox water-tube boilers, each 26 feet 4 inches long, with a drum 3 feet diameter. There are 870 square feet of heating surface to each boiler, and each evaporates a minimum of 2,280 lbs. of water per hour at 120 lbs. pressure, with a natural draught, and the feed water at a temperature of about 200° F.

There are two horizontal double-acting Worthington pumps, with a duplicate feed range, and either capable of delivering through the feed water heater or direct.



Switchboard.

There is enough room in the present boiler house for two more boilers of a larger size.

The feed water heater, which is of Babcock & Wilcox latest design, is fixed in conjunction with the main exhaust pipe, and by an arrangement of valves, can be used, or the exhaust steam sent direct to the atmosphere. There are 35 tubes in the heater, 6 feet 11 inches in length, giving a total of 98 square feet heating surface.

The engine room runs parallel to the boiler house, and contains two Belliss-Parker's direct coupled sets, each of 53 kilowatt capacity. The engines are of Messrs. G. E. Belliss & Co.'s latest patent compound self-lubricating type, having the high pressure cylinder 8 inches diameter, and the low pressure cylinder 14 inches diameter, with a 6-inch stroke, running at 450 revolutions, with 120 lbs. per square inch at the engine stop valve, exhausting into the atmosphere. The cranks are opposite, and two piston valves on the same rod work both cylinders, thus requiring fewer working parts and less space. The engines are fitted with throttle valve governors, driven direct off the crankshaft by means of levers, and a steam separator is also fixed, coupled direct to a Geipel steam strap to carry away automatically all condensed water, and drain and exhaust pipes are fixed in a trench, over which is laid floor plates resting on set angle irons, which renders things easy of access. The L.P. drains have a range of piping to themselves, and the H.P. drains deliver into the exhaust pipes.

The H.P. cylinder is fitted with a metallic packing in the stuffing box, of the well-known Combination Metallic Packing Company's make, of Newcastle-on-Tyne, and provided with an extra gland to take one or two turns of soft packing to prevent water coming down the glands, and which works admirably. The glands are easy of access, both being fitted outside the engine casing by means of a distance piece cast on the trunk guide, and which also forms the bottom cover for the cylinders.

The dynamos are of Messrs. T. Parker's shunt-wound type, for 115 amperes at 460 volts when running at 450 revolutions per minute.

Alongside the engines are fixed two transformers and two boosters, all coupled together, running at 1,000 revolutions per minute. The two boosters are capable of giving 70 volts and 60 amperes, and the transformers 230 volts and 50 amperes.

All the bearings are of the ring automatic type, which Messrs. Parker supply to all machines made by them.

The secondary batteries are of the D.P. Battery Company's type, and consists of 230 cells in glass boxes fixed on wooden trays, and resting on glass insulators containing resin oil. They are capable of supplying 800 8-C.P. lamps for nine hours, or 1,200 8-C.P. lamps for 4 hours.

The switchboard was made by T. Parker, Limited, of Wolverhampton, and is composed of six panels of slate, fitted up with the necessary instruments and switches for working the accumulator, transformers, boosters, and main dynamos. On the one side there are the middle wire and accumulators, and on the other side of the board are the six outer wires, main fuses and dynamo, main automatic cut-out switches and amperemeters. All the meters are of Lord Kelvin's type. There is also on the accumulator side of the board an electrostatic voltmeter made by James White, of Glasgow, which is used as a standard for all the other voltmeters. On the end wall of the engine room are fixed two of Lord Kelvin's engine room voltmeters with 18-inch dials, mounted on teak boards, and below these are two of Lord Kelvin's recording voltmeters mounted in the same manner. Each of these four voltmeters has its own switch, so that any one of them can be cut out of circuit without interfering with the other three.

At the bottom of the switchboard there are four Thomson-Houston wattmeters (not shown in the illustration) two for 100 amperes at 270 volts, and two for 150 amperes at 450 volts. The two of the larger capacity are fixed in the main dynamo circuit, and the two smaller ones take one-half of the accumulator each, each being inserted in the two main leads from the battery house.

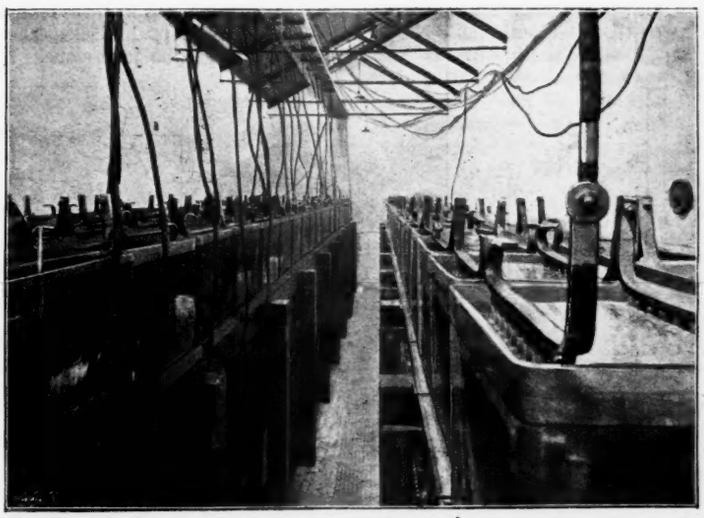
The steam piping is arranged in duplicate. Pipes and bends are of wrought-steel, with welded seams, and heavy forged flanges screwed on hot and brazed. Tee pieces and pocket pipes, are of a special mixture of cold blast hematite and steel, and pipes are carefully drained to Geipel traps. The exhaust pipe is of cast-iron under the engine room floor, covered by W.I. chequer plates. A bye-pass is provided for the feed heater. Feed pipes are arranged in duplicate, with valves to cut off any

section that may fail. Connections are provided to allow of feed pumps, either drawing from river or supply tank, and delivering to either boilers or supply tank. Steam for the pumps is taken from the boilers, independent of main steam.

All the steam and feed pipes are covered with the well-known magnesia sectional covering, manufactured by the Washington Chemical Company, of County Durham. There is a 2-inch thickness of this covering the whole length of the main steam drum of each boiler for half the circumference, the other half being set in the brickwork, and exposed to the flames. *Apropos* of this, there appeared a highly interesting article in our last issue on the various materials in use for covering steam pipes, and the economy which can be ensured by their judicious employment.

A galvanised iron feed tank, holding about 2,500 gallons, is fitted over the lavatories.

The accumulators are charged through boosters, the potential at the switchboard not being altered. These machines are driven by the motors for maintaining the balance of the three-wire system, the armatures being wound on sleeves and slipped on the end of balancer spindles.



Accumulator Room.

The balance of the three-wire system is maintained by the balancer transformers, either of which machines is capable of driving two boosters at full load.

The pressure at consumers' lamps is 210 volts. While the load is small, the accumulators, which are of very large capacity for size of station, will supply all the lamps. Only one shift is expected to be required for some time to come. The supply is on the three-wire system with 420 volts on the outers.

The mains are all of Messrs. Callender's Company's make. The feeders are triple concentric, lead coated and armoured, and the distributors are three-core of the same type, the use of three-core making the fitting of services a much simpler matter. All the mains are laid direct in the ground. The feeder and network boxes are of Callender's standard type, and for this class of cables the ends are sealed with bitumen compound, through which the connections project for the purpose of disconnecting and testing.

There are at present about

Yards.		Square inches.	Square inches.	Square inches.	
8,113	feeders	... ·15	... ·15	... ·075	triple concentric.
3,359	distributor	... ·075	... ·050	... ·075	three-core.
1,771	„	... ·050	... ·035	... ·050	„

The scale of charges is on the maximum demand system, 7d. for first hour, 4d. for second, and 2d. for all following.

There are not very many customers connected at present, only about 12 or 15, but orders are coming in very quickly now that current is being supplied. There is an excellent field for lighting. There are many fine shops and good residential houses, and there is also the celebrated public school, which, with the houses attached, are almost sure to become good customers. The military barracks, burnt down a few years ago, and about to be rebuilt on an extensive scale, the County Infirmary, the Diocesan Training College, a number of breweries, one of which is already lighted, and the various municipal and county public buildings must also be taken into account.

The Hire Wiring system is that adopted, and the cost of the work is spread over 56 equal quarterly payments, interest at the rate of 5 per cent. being charged on the unpaid amount. This means, roughly, 2s. per lamp per annum, taking the wiring to cost 20s. per lamp.

We heartily congratulate Edmundsons' Electricity Corporation upon the workmanlike station erected for the city of Winchester; substantial and plain, yet roomy, light, and airy, with plenty of space for extensions. Winchester is only one of the many places of similar character as regards size and population which Edmundsons have got in hand, as may be gathered from a perusal of our "Electric Lighting Notes" pages in this issue of the Review, and there seems but little doubt that their pluck and enterprise in taking all the responsibility and risk in erecting central stations will meet in most instances, if not in all, with a substantial reward. That such will be the case in Winchester there is scarcely room for doubt, as the station, with its accumulators, is calculated to work with the greatest economy at all times of the day, and with a progressive and enlightened Mayor and Corporation to look after the interests of the city of a thousand years of civic government, "the birthplace of England's greatness," there is no reason why the Winchester central electric lighting station should not speedily be numbered with the commercially successful electricity works of the United Kingdom. We may add, in conclusion, that the negatives of the photos from which our illustrations are reproduced were taken by Mr. W. T. Green, of Winchester.

JOINT TEST: SUPPLEMENT TO RAYMOND-BARKER'S ACCUMULATION NULL METHOD.

By A. D. CONSTABLE.

Investigation at some length having been made on this method, with a view of finding whether in all cases it would prove a really satisfactory joint test, the following supplement to Mr. Raymond-Barker's note (see Electrical Review, May 6th 1898) may be of interest.

The difficulty in all joint tests is that the joints are too good, *i.e.*, the insulation of the short length of core tested is so enormous that the joint leakage is generally swamped by leakage on leads and instruments, and this combined with the necessary low sensitiveness of the galvanometer, if on shipboard, makes the test one of the roughest of qualitative tests rather than an approximate comparison of insulation values. The length of joint or core under test is generally about 18 inches, and, taking temperature as 60° F., the insulation of this length comes out about 15×10^6 Ω for 1,000 Ω per N M core at 75° F.

The accumulation due to lead leakage may give as much as 50 or 60 divisions, while only one or two extra divisions are added when the joint or piece of core is put on.

Mr. Raymond-Barker's diagram may be drawn as in fig. 1 to show the leads from the testing room more clearly:—The lettering is the same with the exception that the writer has used throughout I_2 to denote the standard core, and I_1 to denote the joint, these letters being also used in the formulæ for the respective insulation resistance values.

In the diagram *c d* are the standard core leads, and *a b* those for the joint.

When K_1 is in the charging position, C_1 is charged by leakage through the joint plus that through the insulation of leads *a b*. Leakage from *b* to *c* will not of course tend to

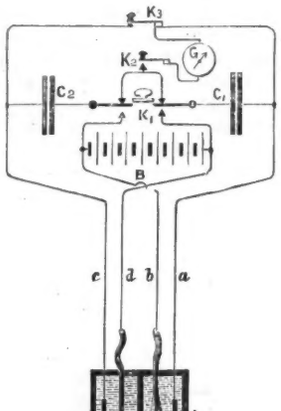


Fig. 1.

charge C_2. But C_2 is similarly charged by leakage through the core I_2 plus that through insulation of *c d*, and since *b* may be a long length of cable, the *c d* leakage may be very different from the *a b* leakage.

The insulation of the trough would require special attention too, but one constructed as in fig. 2 would probably

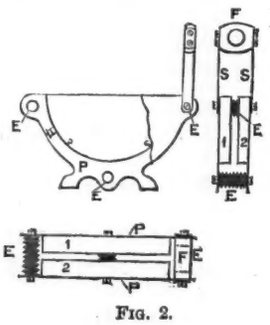


Fig. 2.

be satisfactory. 1 and 2 are the two troughs constructed of thin metal and fixed to stouter side plates of metal, P P, which are shaped to take the three corrugated ebonite insulating distance pieces, E E E, and provided with feet for convenience when not suspended. When in use the trough is suspended on the usual insulating rod by means of the ebonite blocks, F, fixed to the trough by the hard fibre strips S S. By keeping E and F clean, a very high degree of insulation can be obtained between the troughs, and it is as convenient to use as the ordinary single trough.

The modified test, involving the use of adjustable resistance referred to by Mr. Raymond-Barker, is the following :— It has the advantages that lead leakage can be compensated for and only one trough of the usual description is required, and consequently only one earth lead, but by using the same battery only half the E.M.F. is available for each joint, and the simple key, K_3, must be replaced by a second Price or Lambert key minus the galvanometer key K_2. As regards the battery, though, small medical cells are quite suitable and take little room.

As before, C_1 and C_2 are two mica condensers, G the galvanometer, R_1 and R_2 the two resistances across the battery, one or both adjustable, I_1 and I_2 the joint and standard core respectively, K_3 the second Price or Lambert key to replace simple key K_3 in fig. 1. T_1 is an ordinary trough in which both I_1 and I_2 may be placed, but in order to get over the trouble of lead leakage the piece of core, I_2, may be kept in the testing room. The possible degree or two difference of temperature between the testing room and the joint not being of great importance, as the joint may have been hardened in a freezing mixture, and thus have its temperature very vaguely known. A convenient trough for I_2 is a U-tube of metal, with a split rubber stopper in each end. This may be mounted on an insulating stand and connected up once for all at the beginning of a series of tests.

There is required then a lead *a* to the conductor of the cable, and one *b* to the metal of the trough.

It is evident that leakage from *b* to *a* will charge C_1 as well as leakage through the joint, but if *b* is surrounded by a metal shield connected with the terminal, A, of the battery, this shield will intercept this leakage, hence C_1 will be charged by leakage through the joint alone. I_2 being in the testing

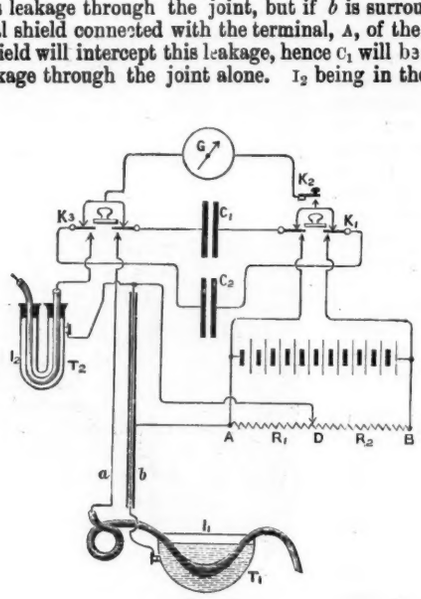


Fig. 3.

room close to the instruments, the leakage through its leads may be made negligible. The lead, *b*, may conveniently be a piece of old L D S type cable, A being the earth terminal of battery, the trough, T_1, being as usual highly insulated.

To make the test, see that the cable has no charge, then first depress K_3, then depress K_1 for 60 or 100 seconds say, then at end of period raise K_1 and immediately raise K_3, taking care that K_1 is up first however. After mixing charges for a few moments, depress K_2, and if there is no throw, $I_1 = I_2$, supposing that $C_1 = C_2$ and $R_1 = R_2$.

If there is any want of balance due to extraneous leakage not being all got rid of, it may be corrected by altering the ratio of R_1 and R_2.

The ratio $\frac{R_1}{R_2}$ gives the ratio $\frac{I_1}{I_2}$ if balance is obtained.

The following is a proof of this :—

R_1 and R_2 are assumed to be negligible compared with I_1 and I_2.

Let Q_1 be the quantity of charge in C_1, after *t* secs.

I_1 the resistance in series with C_1 and V_1 the charging P.D.

Let Q_2, *t*, I_2, and V_2 be the same quantities for C_2,

then from the well-known formula for the rate of charge of a condenser we have

$$Q_1 = V_1 C_1 \left(1 - \frac{1}{e^{\frac{t}{C_1 I_1}}}\right)$$

e being the base of Naperian logarithms. A similar expression holds for Q_2, which is made equal to Q_1.

$$\text{Also } \frac{V_1}{V_2} = \frac{R_1}{R_2} \qquad \text{Let } C_1 = C = C_2$$

$$\therefore \frac{R_1}{R_2} = \frac{1 - \frac{1}{e^{\frac{t}{C I_2}}}}{1 - \frac{1}{e^{\frac{t}{C I_1}}}} = \frac{e^{\frac{t}{C I_1}}\left(e^{\frac{t}{C I_2}} - 1\right)}{e^{\frac{t}{C I_2}}\left(e^{\frac{t}{C I_1}} - 1\right)}$$

$$= \frac{e^{\frac{t}{C}\left(\frac{1}{I_1}+\frac{1}{I_2}\right)} - e^{\frac{t}{C}\cdot\frac{1}{I_1}}}{e^{\frac{t}{C}\left(\frac{1}{I_1}+\frac{1}{I_2}\right)} - e^{\frac{t}{C}\cdot\frac{1}{I_2}}}$$

Let $t = 100$ seconds $\quad C = 10^{-6}$ farad.

Take for example $I_1 = 2 \times 10^6\ \Omega$, and $I_2 = 10 \times 10^6\ \Omega$, *i.e.*,

$$\frac{I_1}{I_2} = \frac{1}{5},$$

substituting in formula

$$\frac{R_1}{R_2} = \frac{e^{6\times10^{-5}} - e^{5\times10^{-5}}}{e^{6\times10^{-5}} - e^{10^{-5}}} = \frac{1{\cdot}000060 - 1{\cdot}000050}{1{\cdot}000060 - 1{\cdot}000010} = \frac{1}{5}$$

Thus for a ratio of 1 to 5 for I_1 to I_2 the proportionality is true, and the nearer to unity is the ratio $\frac{I_1}{I_2}$, the more nearly does $\frac{I_1}{I_2} = \frac{R_1}{R_2}$.

Since it would take too long to get balance by adjusting R_1 and R_2, it is better to take a given ratio, say, unity, and read the throw given by $Q_1 \sim Q_2$, and by reference to a table previously calculated find I_1.

The capacity of the condensers used need only be very small, and need not be exactly the same for both, since the charge taken up is so small a fraction of the full charge possible that the charging current is simply dependent on the ohmic resistance of the piece of core, and the quantity, which is the mean current × time is therefore independent of the condenser capacity. This is seen at once by trial from the formula

$$Q = C\,V\left(1 - \frac{1}{e^{\frac{t}{C\,I}}}\right)$$

as long as I is very large it will be found that Q is independent of C.

An ordinary Thomson marine galvanometer will not give more than 200 divisions deflection for a discharge from a 1 microfarad condenser charged to a P.D. of 1·5 volts.

This is equivalent to one division for $0{\cdot}75 \times 10^{-8}$ coulombs, so that a difference of about 10^{-8} coulombs is the minimum observable.

What is actually to be measured may be worked out. Taking the insulation of the standard core to be $12 \times 10^6\ \Omega$ at testing temperature, equivalent to 800 Ω per nautical mile at 75° F.

C_1 and C_2 each as 1 microfarad, R_1 and R_2 equal, battery 400 cells so that $V_1 = V_2 = 300$ volts, $t = 120$ seconds.

$$\text{Then } Q_2 = 300 \times 10^{-6}\left(1 - \frac{1}{e^{\frac{120}{10^{-6}\times 12\times 10^{12}}}}\right)$$

$$= 0{\cdot}30 \times 10^{-8} \text{ coulombs.}$$

$$Q_1 = 300 \times 10^{-6}\left(1 - \frac{1}{e^{\frac{120}{10^{-6}\times I_1}}}\right)$$

The following table gives values worked out of Q_1, and also $Q_1 - Q_2$ for different values of I_1.

I_1	Q_1	$Q_1 - Q_2$
$15 \times 10^6\ \Omega$	$0{\cdot}24 \times 10^{-8}$	$-0{\cdot}06 \times 10^{-8}$
12×10^6	$\cdot30 \times 10^{-8}$	0
9×10^6	$\cdot40 \times 10^{-8}$	$+0{\cdot}10 \times 10^{-8}$
6×10^6	$\cdot60 \times 10^{-8}$	$\cdot30 \times 10^{-8}$
3×10^6	$1{\cdot}20 \times 10^{-8}$	$\cdot90 \times 10^{-8}$
1×10^6	$3{\cdot}60 \times 10^{-8}$	$3{\cdot}30 \times 10^{-8}$

Hence, unless I_1 was only $\frac{1}{4}$ I_2, there would be no difference observable. Since the standard core only gives $0{\cdot}3 \times 10^{-8}$ coulomb charge, this could not be detected on an ordinary marine galvanometer, and the test is consequently reduced to the ordinary simple test, and one at that which cannot distinguish between joints unless the ratio of their insulations is at least 1 : 4.

With lower insulation cables, or if a longer time of charging is used, the test would work better, but what is really necessary is a much more sensitive galvanometer such as would only be used in a factory and not on shipboard. It is in the factory after all that most of the joints are made.

The point of difference between the ordinary joint test and the "null method" is this: in the former two separate readings are taken and the difference taken by ordinary subtraction; in the latter the charges go on simultaneously in two separate condensers, and the subtraction is performed automatically by the operation of mixing. But instead of taking the two charges separately, the difference only need be taken in one condenser, which is discharged through the galvanometer after the required time. This simplifies the "null method" down to an ordinary Wheatstone's bridge measurement without losing any of the advantages.

The connections are shown in fig. 4. I_2 is in this case

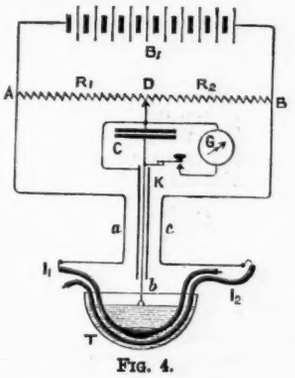


Fig. 4.

shown in the same trough as I_1, as lead leakage is as easily compensated for as when I_2 is in the testing room.

a and *c* are the leads to the conductor of joint and core respectively, *b* is the lead to the metal of trough, which must be well insulated as usual. This lead *b* is shielded to intercept leakage, and may consist of a piece of old L D S cable, as in the former case. D is earthed, and the rest of the instruments and the battery must be well insulated.

To show that the arrangement is no less sensitive than the former more complicated one, an example is here worked out. Take R_1 and R_2 equal $I_1 = 3 \times 10^6\ \Omega$ and $I_2 = 12 \times 10^6\ \Omega$. Since as before R_1 and R_2 are negligible compared with I_1 and I_2, the condenser C may be considered as charging with the P.D. V_1 volts existing between T and D through a resistance equal to the parallel resistance of I_1 and I_2.

The P.D. at the terminals of a Wheatstone bridge, with arms R, R_2, I_1, I_2, as in fig. 4, is given by the formula—

$$V^1 = V\,\frac{(R_1 I_2 - R_2 I_1)}{(I_2 + I_1)(R_2 + R_1)}$$

or where $\frac{R_1}{R_2} = 1$ $\qquad V^1 = \frac{V\,(I_2 - I_1)}{2\,(I_2 + I_1)}$

I_2 being greater than I_1, V is the battery P.D.

Hence, in the present example, assuming the battery to be 400 cells as before—

$$V^1 = \frac{600\,(12 - 3) \times 10^{12}}{2\,(3 + 12) \times 10^{12}} = 180 \text{ volts.}$$

The charge taken up by C may, as shown above, be taken as the charging current × time. $\frac{12 \times 10^{12}}{5}\,\omega$ is the parallel resistance of I_1 and I_2. Time = 120 seconds ∴ $Q = \frac{180 \times 5}{12 \times 10^{12}} \times 120 = 0{\cdot}9 \times 10^{-8}$ coulomb.

This is the same result as in the former case.

Summarising, it is seen how the usual unsatisfactory method of testing joints may, by following the lines indicated, be raised from a test which shows merely whether the joint is fairly good or absolutely faulty to a more or less exact comparison of insulation resistance, and this by no more than a slightly modified Wheatstone's bridge measurement, or by one of the other equivalent tests.

Experiments have been made on short pieces of core which corroborate the conclusions arrived at theoretically, and for the facilities afforded for them the thanks of the writer are due to Mr. J. Rymer-Jones, of Silvertown, and also to Mr. Raymond-Barker, for permission to work out more completely his original idea, and make the result public.

SOME NOTES ON THE ELECTRO-DEPOSITION OF PLATINUM.

By SHERARD COWPER-COLES.

The resistance of platinum to the action of corrosive acids renders it invaluable for the coating of chemical and electrical apparatus. Considerable difficulties have been experienced in obtaining a satisfactory deposit of platinum, the thickness of the coating being very limited. Smee was one of the first to study the conditions under which good metallic deposits of platinum could be obtained. He obtained the best results with a solution composed of nitro-muriate of platinum, to which sufficient soda was added to render it neutral. He used as an anode a fine platinum wire, oxygen gas being given off from the platinum wire, and no gas evolved at the cathode. Smee designated obtaining bright deposits of platinum as platinating, in contradiction of platinising. To platinise metals, according to Smee, a strong current is used to decompose the water, and drive off hydrogen at the cathode, so as to produce platinum sponge or black. Roseleur has also given considerable attention to the electro-deposition of platinum; he claims to have obtained thick deposits of platinum from a solution composed of 10 parts of platinum converted into chloride dissolved in 100 parts of distilled water. If any cloudiness appeared in the solution when the chloride was dissolved in the water (due to overheating in the last stage of evaporation), the solution was passed through a filter. One hundred parts of phosphate of ammonia (crystallised) were then dissolved in 500 parts of distilled water, and the solution added to the platinum liquid with brisk stirring, when a copious precipitate formed. To this was next added a solution of phosphate of soda, consisting of phosphate of soda 500 parts, distilled water 10,00 parts. The above mixture was boiled until the smell of ammonia ceased to be apparent, and the solution, at first alkaline, reddened blue litmus paper. When the yellow solution became colourless, and was ready for use; the solution is used hot, with an E.M.F. of 7 to 8 volts; Roseleur recommends it for depositing platinum on brass, copper, and German silver. As the platinum anode is not dissolved, fresh additions of chloride must be constantly added. The writer has been unable to obtain thick deposits from this solution; the platinum, after it has obtained a certain thickness has a great tendency to exfoliate. For a short time a process was carried on by the Platinum Plating Company, Limited, which was practically identical to the above, with the exception that a small addition was made of chloride of sodium; this solution gives no better results than Roseleur's. Boettger's solution for depositing platinum consists of the double chloride of platinum and ammonia dissolved in water to which a few drops of liquid ammonia is added. The solution is worked warm.

Another solution of Boettger's consists of the double chloride of ammonia dissolved in 8 parts of salammoniac and another of the double chloride of platinum and ammonia freshly precipitated at a boiling temperature, dissolved in a concentrated solution of neutral citrate of sodium. The resulting liquid is a deep orange colour with a feeble acid reaction, and should be worked cold with a current density of about 3 amperes per square foot, and an E.M.F. at the terminals of the bath of 7·5 volts. If the solution contains about 1½ ozs. of platinum to the gallon of solution, excellent bright deposits are obtained.

Gore, in his book on "Electro-Metallurgy," refers to a solution of chloride of platinum dissolved in one of cyanide of potassium, the proportions of metal being kept at about 1 oz. to the gallon; the bath being used warm. Jewreinoff affirms that the platinum anode is dissolved freely in a solution composed by dissolving 10 parts of metallic platinum which has been converted into chloride in 10 parts of caustic potash in water, the yellow precipitate being dissolved by the addition of 20 parts of oxalic acid in aqueous solution with the aid of heat. To this solution is added 30 parts of caustic potash solution. The solution is strongly alkaline. Jewreinoff has also used another bath for the deposition of platinum, in which he converts three parts of platinum into chloride and dissolves this in 300 parts of distilled water, to which is added 25 per cent. of sulphuric acid. He also recommends the use of platinum anodes in this bath.

A SHORT METHOD OF DETERMINING TRANSFORMER EFFICIENCIES.

In conducting calculations of any kind it is always convenient and advisable to reduce numerical calculations as much as possible, not only on account of the consequent reduction of labour, but also because the liability of error is thereby as nearly as possible eliminated.

An example of this is given by S. E. Johannesen, in a recent issue of the *Electrical World*, where he shows that the usual working formula for the calculation of transformer efficiencies may be, with advantage, simplified before proceeding to insert the numerical data.

The efficiency formula generally used is :—

$$\eta = \frac{100\,x\,W}{W_1 + (x\,i_1)^2\,r_1 + (x\,i_2)_2\,r^2 + x\,W} \qquad (1)$$

Where W is the full rated capacity of the transformer in watts,
i_1, i_2 the full load primary and secondary currents,
r_1, r_2, the primary and secondary resistances,
W_1 the iron loss in watts
and x that fraction of full load at which the efficiency is desired.

Formula (1) may be written

$$\eta = \frac{100\,x\,W}{W_1 + x^2\,(i_1^2\,r_1 + i_2^2\,r_2) + x\,W}$$

$$= \frac{100\,x\,W}{W_1 + x^2\,W_2 + x\,W}$$

where W_2 is the copper loss in watts at full load.

Now dividing both numerator by $\frac{W}{100}$ we get—

$$\eta = \frac{10{,}000\,x}{\frac{100\,W_1}{W} + x^2\,\frac{100\,W_2}{W} + 100\,x}$$

The terms $\frac{100\,W_1}{W}$ and $\frac{100\,W_2}{W}$ are respectively the percentage iron and copper losses at full load, and $100\,x$ is the percentage of the load at which the efficiency is desired.

To illustrate the method the following efficiency problem is worked out.

Determine the efficiency at three-quarter load of the following transformer :

Rated capacity	6,250 watts.
Primary voltage	1,000
Secondary voltage	100
Primary resistance	1·6 ohms.
Secondary resistance	0·016 ohm.
Iron loss	107 watts.
Primary current at normal voltage ...	6·25 amperes.
Secondary current	62·5 „

From these data we get—

$$\frac{100\,W_1}{W} = 1{\cdot}712 \text{ and } \frac{100\,W_2}{W} = 2$$

whence

$$\eta = \frac{7{,}500}{1{\cdot}712 + \left(\frac{75}{100}\right)^2 \times 2 + 75} = 96\,35 \text{ per cent.}$$

LEGAL.

Mica Insulator Company v. Electrical Company.

The hearing was resumed on Thursday last week, as stated in our last issue.

Mr. A. F. Galpin gave evidence of the use of mica under certain conditions in ring and drum armatures, made at the works of Messrs. Johnson & Phillips in 1890.

Prof. Silvanus Thompson, examined by Mr. Terrell, said he was acquainted with the use of mica for electrical purposes before the date of Dyer's specification, and had seen various kinds of built-up mica. He found no substantial difference between the inventions of Scott and Wood.

Mr. Justice Kekewich: I cannot go into that; you are both agreed that Scott is an anticipation of Wood.

Mr. Terrell (to witness): Are the differences between Wood's specification and Dyer's exactly the same as those between Scott and Dyer's?

Mr. Moulton objected to this leading form of question, and it was not pressed.

Witness, further examined, said that at the Electrical Construction Company's works about 1889 or 1890, he saw mica made up in narrow strips 3 or 4 feet long, of pieces about an inch wide and 2 inches long, cemented together by shellac, layer on layer. About the same date, at Johnson & Phillips's works, he saw mica used in small pieces, cemented by shellac so as to overlap: this was generally built up on a basis of tissue paper. Witness was a member of the jury at the Crystal Palace show, and saw there machines in which mica was used as an insulator. He particularly remembered Messrs. Wiggins's exhibit, which included two or three commutator rings made of built-up micanite—some built up of flat pieces of mica, each layer overlapping the layer below, and cemented with shellac. He also saw a cone ring.

As an electrical engineer, is there any substantial difference between that and the substance called in this case micanite?—I think there is no difference in the substance as a product, though there may be differences in the manufacture.

From the point of view of an electrical engineer you say this built-up mica fulfils the same functions?—Certainly, and in the same way.

Cross-examined by Mr. Fletcher Moulton: Do I understand you that there is no substantial difference between Dyer's and Wood's specifications?—I see none.

I believe the Allgemeine Elektricitäts Gesellschaft, of Berlin, are the real defendants here, are they not?—I do not know. I have seen their works.

Am I wrong in saying there are something like 300 hands continuously making micanite?—I have not seen that department. I admit micanite is very largely used.

Did you ever know of built-up mica shaped after it was made before the date of this patent?—Yes, the strips I saw at the Electrical Construction Company's works were bound round armatures.

Did you ever know of any built-up mica moulded under heat before the date of the patent?—I do not know that I do.

Is it not a valuable property of micanite that it can be made in sheets without shaping the mica, and cut up and moulded afterwards?—Undoubtedly.

Re-examined by Mr. Terrell: The property in micanite of being moulded was due to the shellac, which became soft when heated and hard when cold, and that was inherent to all combinations of mica and shellac before the date of the patent. It was common knowledge that to get a brittle substance to bend it must be very thin.

Mr. Terrell: That will be our case.

At this point Mr. Fletcher Moulton applied for an adjournment to enable him to get additional rebutting evidence as to the uses of mica at the Brush Electrical Company's works before the date of the patent.

Mr. Justice Kekewich refused to grant an adjournment.

Additional witnesses for the plaintiffs were then called.

Mr. Sillar, works manager to the Brush Company at the London works from 1884 to 1889, and since that time at the Loughborough works, said he did not know of any mica material used in the Brush Company's works in sheets like micanite before the year 1892, nor any mica substance which could be moulded *in situ*. Witness contradicted some of the evidence by Wood and Sawyer, two of defendants' witnesses from the Brush Works, as to the method of building up mica sheets.

Mr. Hodgkin, the present works manager at the Brush Company's London works, who had been employed by that company since 1882, gave similar evidence.

Mr. J. A. Burton, foreman in the Brush Company's works since 1881, and engaged in dynamo work since 1883, did not know of any mica built up like micanite and moulded during his employment.

Mr. Fletcher Moulton then summed up the plaintiffs' case, arguing that Wood's patent was invalid, and that there was no ground for the allegation of anticipation by Scott. The serious questions were the alleged anticipations by prior user. The essence of micanite was that no shaping was necessary, and in that it differed from all previous products of built-up mica, in which scales of mica had to be cut to the shape required. Counsel dealt in great detail with the various anticipations alleged, arguing that all were essentially different from micanite.

Without calling upon Mr. Terrell for the defendants,

Mr. Justice Kekewich delivered judgment, observing that he was unable to see any substantial difference between Wood's patent and Dyer's patent. Both men started precisely from the same basis. Both took thin mica. Both took simple layers. Both took care to exclude from the invention what was called comminated mica. There was a question whether Wood thought the use of irregular sheets of value, but he contemplated them certainly. Both inventors proposed overlapping edges. It might be that neither patentee foresaw—it was probably so—the many great advantages which the manufactured article would have, but Wood did contemplate moulding, or at any rate, bending and pressing quite as much as Dyer. Subject to one exception, it seemed to his Lordship that the two specifications ran on parallel lines. Where they differed was this: Wood contemplated the use of some fibrous material, tissue paper or cloth, for backing the mica, or putting it on both sides, or in certain cases putting it in between the mica plates. It was obvious that he did not see that mica built up in the way which he proposed—small irregular pieces with shellac—would do well enough without the addition of the fibrous material, and he intended the fibrous material to be used in order to obtain the objects which he thought it would secure. But it would be going much too far to say that this was the essence of the invention. Dyer's specification was really, as regards the words, the pith and marrow of Wood's, without the addition which Wood thought to be necessary, but which by experience was found not to be necessary. But objection was taken that Wood's was not a good prior grant, but was invalid, and had been anticipated by Scott and Thompson. The defendants, by rejoinder, said that they agreed to that. Wood's patent was consequently out of the way as an invalid grant. Then if his conclusion was correct that Wood's and Dyer's patent were the same, it must follow that Dyer, in his patent, had been anticipated by Scott and Thompson. Of course, if his conclusion respecting Wood's patent was wrong, then it must be admitted that Scott and Thompson were not anticipations of Dyer. Apart from Wood, he had plenty of evidence that Scott and Thompson were anticipations of Dyer, but he need not go into that. As regards the evidence of prior user, some of it was conflicting, but it was sufficient for his purpose to take that of Prof. Silvanus Thompson, about which there was no doubt at all. No attempt was made to break it down. If he struck out everything about which there was a conflict and retained only that stated by or corroborated by Prof. Thompson, there was quite enough to confirm prior user again and again against the plaintiffs. On these two grounds the plaintiffs' case failed, and the action must be dismissed with costs.

Crawford v. The City of London Electric Light Company, Limited.

This case came before a Divisional Court of Queen's Bench consisting of Mr. Justice Day and Mr. Justice Ridley on Friday last on a special case stated by Sir James Ritchie, an Alderman of the City of London sitting at the Guildhall, on an application made to him on March 25th by the appellant, the City Solicitor, to ascertain the amount of "fees and reasonable expenses of an electric inspector" under the provisions of the Electric Lighting Orders Confirmation (No. 15) Act of 1890.

The facts were, shortly, as follows:—Mr. A. A. Voysey was appointed electric inspector by the appellants, and paid a salary of £250 a year. Two-thirds of his time was given to the work of inspection, and the remaining one-third to other duties connected with the Corporation. All fees received by him were to be accounted for to the Corporation. The sums set out in the special case were paid by the Corporation, and the alderman found that they were reasonable and proper expenses in themselves except as to one-third of the salary of the electrical inspector. The amounts were as follows:—Rent of electrical laboratory, £390; expenses of gas for heating, electricity for lighting, cleaning, coals, and insurance, £28 6s.; wages of assistants, £142; depreciation in the value of the furniture, fittings and instruments, together with interest on capital outlay, £52 12s. 10d.; salary of the inspector from July, 1894, to Christmas, 1896, £613 3s. 9d.; total, £1,226 2s. 7d.; less fees received by inspector, £84; balance, £1,142 2s. 7d. The alderman found that the amount of the fees was £84, and that there were no "reasonable expenses" of the inspector within the meaning of the Act, and that therefore the company were not liable to pay the Corporation anything beyond the £84 admitted. The alderman, however, alternatively found, in case he should be wrong in his law, that the sums set out above were reasonable and accurate if the Court should be of opinion that the company ought to repay the same to the Corporation. He only allowed, however, for two-thirds of the inspector's salary, as the inspector only devoted two-thirds of his time to this work. The material section of the Act was Section 47, which provides that all fees and reasonable expenses of an electric inspector shall, unless agreed, be ascertained by a Court of summary jurisdiction, and should, in the absence of any agreement to the contrary between the undertakers and the local authority, be paid by the undertakers; provided that when the report of an electric inspector, or the decision of the Board of Trade, showed that any consumer was guilty of any default or negligence, such fees and expenses should, on being ascertained as above-mentioned, be paid by such consumer or consumers as the Court or Board should direct, and might be recovered summarily as a civil debt. Counsel for the respondents submitted that none of the items making up the sum of £1,142 2s. 7d. came within the description of "fees and reasonable expenses of an electric inspector" within the meaning of Section 47. Counsel for the appellants submitted that the magistrate's only jurisdiction was to ascertain the sum that was properly incurred as (fees and reasonable expenses) of the electric inspector.

Mr. Rose Innes now appeared for the appellants, and Mr. Roskill for the respondent.

Mr. Rose Innes submitted that the alderman had gone wrong on the interpretation of Section 47. He should have said that the £900

odd, after deducting one-third of the salary, was the proper amount payable by the electric company. The expenses of a reasonable office and laboratory were the reasonable expenses to be paid by the company.

Mr. Roskill contended that the expenses set out did not come within the words "reasonable expenses" in Section 47 of the Act. The word "expenses" in the Section meant the expenses incurred in each particular investigation, and would include cab fares and other incidental expenses. It would be monstrous to charge a consumer with general expenses. The fees to be taken by the inspector were created by Sections 35 and 36, and there could be no question about them.

Mr. Justice Day, in giving judgment, said he saw no reason to disturb the decision of the alderman. If the Court could give the appellant the right to appeal he personally should be very glad, but he thought it was out of its power.

Mr. Justice Ridley agreed. He said that when one came to look at Section 47 as a whole it became necessary to consider what expenses could be thrown on the consumer in certain cases. It might have been more difficult to interpret the words fees and expenses in the first portion of the Section but for the latter part. In his view, "such expenses" were the expenses connected with the inquiry into the meter and such like, in each particular case with each particular consumer in default. No default of a consumer could have anything to do with the expenses set out by the alderman in his alternative finding.

The appeal was therefore dismissed with costs.

Cooper *v.* Electrical Installation Company.

This appeal, which was heard on Thursday last week (see Electrical Review, July 1st), was concluded the same day.

Mr. Cox, replying on the whole case, said that the burden of showing that the statement of claim as amended disclosed no reasonable cause of action was on his learned friend.

The Master of the Rolls: He has satisfied the learned judge and now the burden is on you, you know. How do you put it now in your best and most seductive form to get something out of it?

Mr. Cox replied that he had relied on the case of Weiderman *v.* the Société Generale when he was before the Court on a former occasion. The fatal defect then was a want of proper notice. What he now said was that he had so amended the plaintiffs' claim as to bring it within the case cited. On the statement of claim he had shown that the plaintiff had reasonable cause of action. He submitted that by his amendment he had made as definite a claim to his right to have royalties as was alleged in the case cited. It would be unjust, he submitted, to deprive the plaintiff of the only substantial relief he could by any possibility get by the original assignment by him and the subsequent dealings under that assignment. The Electrical Installation Company had no earthly existence. The O'Brien Leonard Company were the only people the plaintiff could hope to get anything out of. Surely he was entitled to ask whether or no notice by the Electrical Company to the O'Brien Leonard Company did not entitle him to say that the latter company were bound by the covenants in the original assignment. He contended that the plaintiff was entitled to demand whether the O'Brien Leonard Company had infringed his rights.

Mr. Wallis said there could be no doubt that the O'Brien Leonard Company were the holders of the patent in question. But they had never desired to use it all. He offered his learned friend, on behalf of the company, to give him back his half share of the patent, so that the O'Brien Leonard Company took only the share which the Electrical Installation Company had a right to. The substance of it was that the thing was not really worth fighting about. There was no evidence of keeping plaintiff out of a penny piece. He submitted that the O'Brien Leonard Company had been right all the way.

The Master of the Rolls: Can't you settle the whole of the litigation, Mr. Cox.

Mr. Cox said the plaintiff was not in Court, and he could not say how far his friend's offer would satisfy him.

After further discussion their Lordships reserved judgment till Wednesday next, in order to enable the parties to try to come to some arrangement, settling the whole litigation.

Fricker *v.* Whelan.

In the Westminster County Court on Monday, his Honour Judge Lumley Smith, Q.C., disposed of this action which was brought to recover £6 10s., balance of account for electrical work done.

The case for plaintiffs was that the statement of account produced, showing this sum to be due, was correct. Plaintiffs carried out an installation, lent certain arc lamps, maintained the light, &c., at defendant's order for a show he was giving at the Royal Aquarium Theatre, Westminster.

His Honour: What was the show?

Mr. Fricker (one of the plaintiffs): It was for "Zaeo Dancing in Electric Lights."

Defendant contended he had only been allowed £1 for five times that the light failed. Once he had to return the money of the public as the utter failure of the light prevented any show at all. He thought £10 should be allowed him for the failures.

For the plaintiffs it was urged that sufficient allowance had been made for the one and only time the light failed.

His Honour said defendant was entitled to expect to have what he ordered, and reduced the claim by one half, giving judgment for the plaintiffs for £3 5s.

Smoke Nuisance in Paddington.

At the Marylebone Police Court last week, Mr. Lane heard an adjourned summons taken out by the Paddington Vestry against the Metropolitan Electric Supply Company, Limited, for allowing black smoke to be sent forth from the chimney in connection with the company's generating station at Amberley Road, Paddington, in such quantities as to be a nuisance. The case was first before the Court on May 26th, and was then adjourned *sine die*, the defendant company undertaking to do their best under the circumstances to abate the nuisance.

Mr. Byron, barrister, who appeared for the Vestry, now stated that there had been practically no difference in the volume of smoke emitted from the chimney, and pointed out that the volume was much greater than in the case of several other such chimneys in the adjoining districts.

Mr. Spencer Bowen, barrister, who defended, admitted that the nuisance still existed, but called evidence showing that owing to the Welsh coal strike, and the consequent inability of the company to obtain an efficient supply of smokeless coal, it was inevitable.

Mr. Lane remarked that the engineers in connection with other stations referred to by the prosecution had not been called, and in the absence of their evidence he must accept the testimony of the engineer at the station in question and other witnesses, and dismiss the summons.

John Dewar & Son *v.* Day.

In the Westminster County Court on Wednesday, this case was disposed of by Judge Lumley Smith, Q.C., and was an action for detinue for the delivering up of an electric sign. Plaintiffs were whiskey distillers and advertised a good deal by electric signs. One was outside the "Coach and Horses" in the Strand, the public house of the defendant. Plaintiffs' electrician had made every endeavour to get the sign, and had seen it in defendant's cellar damaged to the extent of £20. It was worth £60 when complete.

His Honour gave plaintiffs judgment for £20, to be reduced to 1s. if the sign was given up.

Helios Elektricitats Actien Gesellschaft *v.* Braulik.

Before Mr. Justice Bigham, sitting as an additional Judge of the Chancery Division, on Wednesday an action was brought for infringement of patent by the Helios Elektricitats Actien Gesellschaft against M. Braulik. Mr. Fletcher Moulton, Q.C., and Mr. Sebastian were for the plaintiff company, and Mr. Astbury, Q.C., and Mr. Graham for the defendant.

Mr. Sebastian said the infringement complained of was that of Patent 18,245 of the year 1888 for certain improvements in electric lamps, and the ground of action was the alleged infringement of the second claim in the specification, which consisted of a description of a new electric lamp. He would therefore confine himself to the second and third claims, which were comparatively simple. He would not trouble his Lordship by going through the description of the lamp as a whole, but the description of the part in dispute showed that a reflector was put on the bridge piece in a particular position, and was either a part of the bridge piece, or affixed to it. The action was brought for infringement of the second claim, which described the construction of the bridge piece. The defendant admitted the sale of the lamp, which was alleged to be an infringement of the patent, but there was a denial of the lamp being an infringement of the letters patent, which were stated to be invalid on the grounds stated in the particulars of the objection. Putting it shortly, it was stated that the invention claimed by the second claim was anticipated by certain lamps which were said to have been fitted with reflectors attached in the same way, and manufactured by Messrs. Crompton & Co., of Chelmsford, and which were used to light the Mansion House in 1883.

Mr. Justice Bigham: If I find against you on all these points, we may dispose of the action. We had better have the evidence. Can you tell me why the application of a reflector should be the subject of a patent?

Mr. Sebastian: It was an innovation very much needed to show the lamp to the best advantage, particularly at the time when the arc lamp was being introduced, and it was necessary to say the exact spot where it should be fixed so as to produce the best results.

Mr. Justice Bigham: As to its being the subject of a patent, surely reflectors are as old as lamps.

Mr. Sebastian: I will not say that was an innovation on an entirely new line of thought, but it was innovation adding to the value.

His Lordship: What I am objecting to is that it is not an innovation or an invention.

Mr. Sebastian: I say that it is something which the patentee found out, and therefore an invention.

His Lordship: Did he find out that a reflector was a useful addition to an electrical lamp?

Mr. Sebastian: We are not claiming all reflectors, but we are claiming as to the particular spot to fix them.

His Lordship: Are you going to call experts to tell me that a reflector applied to a lamp is an invention?

Mr. Sebastian: Not any reflector, but as placed as in this case.

His Lordship: What is the peculiarity of it?

Mr. Sebastian: The peculiarity about it is that it is placed in the best possible position to show the light.

His Lordship: But is not every reflector placed in the best possible position to the light it has to reflect, and can they all be made the subject of a patent.

Mr. Sebastian: Reflectors to electric lamps had been used for a considerable time, but up to the time of this patent nobody had invented the best way of fixing them. He called Prof. Silvanus Phillip Thompson.

Mr. Sebastian: You have heard the point to which his Lordship's attention has been directed as to the utility and use of the invention detailed in the second claim. Will you take one of the lamps and state your views of it?

Witness: An angle iron disc serves as a bridge upon the cross frame of the lamp, and serves, also, as a reflector of the arc light, which is formed about half an inch below. The arc lamp in a room is designed to throw its light mainly downwards. The arc lamps down to 1884 did not do so of themselves, because up to that time they were practically, without exception, served with a descending current. When the current descends only, it goes in one direction, and you always find that the prepared carbon becomes hollowed out all round, and that throws the light mainly downwards, but it diminishes the light. But from 1884-5 onwards, lamps came into use which worked with alternating currents, and in these the current first goes up and then down in rapid succession, with the consequence that when the currents go upwards the light from the carbons is thrown downwards, and *vice versâ*, and it becomes important to obtain proper means of throwing downwards that part of the light which otherwise would be thrown upwards. In this patent the problem is solved by placing the mirror of a particular kind in the place where it is of the best advantage for throwing downwards the light that otherwise would be thrown upwards. As an effect of recent improvements and reflectors like this the carbons are consumed more slowly, and there is an increased amount of light.

His Lordship: Can you tell us as to the lamp of Crompton and Co.?

Witness: I can only say that two years ago, when I was asked to advise the plaintiff on this particular specification, I made a very careful search among all my documents and notes, and I succeeded in finding none in which there was a large open reflector in the proper place, or suitable for use in an alternating arc current lamp. I have made inquiries as to Crompton & Co.'s lamp, and have been shown a lamp which is alleged to be a lamp of the same sort as those used in the Mansion House.

Mr. Justice Bigham: What was the result?

Witness: I have examined that lamp. The lamp which was shown to me at the office of the defendant's solicitors appears to me to be an entirely experimental lamp. It has a broad bridge, which passes across the framework, and it is not clear whether it is above the arc or below it, and on the upper side, attached by clamping screws, there is a round piece of tin, which is not insulated.

Mr. Astbury: Is it your view that in 1888 a reflecting lamp was known of for alternating currents?—Only in an alternating current lamp.

Don't you know there were scores of lamps previous to 1888 of gas and oil with reflectors, and that the reflectors were above and below the light when it was reflected to the best advantage?—Yes.

Is there any difference between Crompton's lamp and the plaintiffs' lamp?—Yes; because it is not placed in the most advantageous position in the former.

Suppose you turn the piece of tin round; would there be the slightest difference?—It depends where the arc is.

Are they not identical if the reflector is placed on the under side of the bridge pin?—Yes, if it is placed underneath and the reflector is properly polished.

His Lordship: I cannot for the life of me see how there can be any subject matter for this patent. I shall want you to tell me that afterwards, Mr. Moulton.

Mr. Moulton: I can do so. Now, Prof. Thompson, is it the same thing having a reflector under the arc as having it over the arc?—No.

What is the proper place for the actual good working of a lamp for the reflector?—The proper place for a reflector is to have it so placed as to throw the light downwards, or immediately surrounding the lower end of the upper carbon.

His Lordship: Have you any witnesses, Mr. Moulton? I think Prof. Thompson has told me everything I want to know.

Mr. Moulton: The defendant relies on anticipation, and I should like to have that strictly proved.

Mr. John Haydon Greenhill, consulting electrical engineer, gave evidence as to the lamp by Crompton produced in Court being sent to his works at Belfast, he having received it from Messrs. Crompton in the latter end of 1883, or the beginning of 1884. The lamp had no reflector on it then, but it had now. It reflected the light downwards—at least he believed so. He saw the lamp first of all at the Mansion House, and thinking he would like to have them for use in Ireland, he wrote to Messrs. Crompton for them.

Mr. Justice Bigham: That is the defendant's case. Have you anything to say Mr. Moulton?

Mr. Moulton said he could not call any evidence as to the lamp produced.

Mr. Justice Bigham: Well, then, I have made up my mind about it, unless you think you can alter it.

Mr. Moulton: I submit that the evidence is very loose as to anticipation, because the lamp itself is very different to what this was when it was first used.

His Lordship: I am satisfied that in this case there has been anticipation, and, so far as I am concerned, I do not think that the reflector is proper subject matter for a patent at all. So that there will be judgment for the defendant, with costs.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending July 5th, 1897.	£	s.
Adelaide	109	0
Amsterdam	260	0
Antigua. Teleg. mat....	22	0
Antwerp	48	0
Barcelona	50	0
„ Teleg. mat.	85	0
Bombay	92	0
Brisbane. Teleph. cable	1,808	0
Boulogne	18	0
Calcutta	627	0
Cape Town	188	0
Chinde. Teleg. mat. ...	910	0
Colombo...	74	0
Durban	223	0
East London	343	0
Flushing	30	0
Fremantle	67	0
Hamburg	10	0
Madeira	245	0
Madras	39	0
Malta	23	0
Melbourne	196	0
New York	60	0
Port Elizabeth	79	0
Rio Janeiro. Teleg. mat.	1,078	0
Rouen	100	0
St. Petersburg	12	0
Singapore	110	0
„ Teleg. mat.	50	0
Stockholm	500	0
„ Teleg. wire...	20	0
Sydney	98	0
Teneriffe	10	0
Wellington	305	0
Yokohama	60	0
Total	£7,949	0

Week Ending July 5th, 1898.	£	s
Albany	143	0
Amsterdam	50	0
Auckland	324	0
Bangkok	65	0
Barcelona	13	0
Bombay...	51	0
Buenos Ayres. Teleg. mat.	110	0
Calcutta	111	0
Cape Town	457	0
Durban	76	0
East London	62	0
Flushing	37	0
Gothenburg	97	0
Hamburg	300	0
Kolding. Teleg. mat. ...	471	0
Malaga	18	0
Melbourne	1,474	0
Monte Video	25	0
„ „ Teleg. mat.	39	0
Otago	103	0
Port Elizabeth	159	0
Rio Janeiro	11	0
Rotterdam. Teleg. mat.	25	0
Santander	175	0
Santos	205	0
St. Petersburg	16	0
Singapore. Teleg. mat.	208	0
Spezzia	636	0
Stockholm. Teleg. cable	1,189	0
Sydney	778	0
„ Teleg. mat. ...	240	0
Wellington	125	0
„ Teleg. mat. ...	100	0
Total	£7,893	0

Foreign Goods Transhipped.

	£	s.
Launceston. Elec. meters	400	0
Total	£400	0

	£	s.
Hong Kong. Teleg. mat.	178	0
Trinidad. Teleph. mat.	62	0
Total	£240	0

Bankruptcy Notice.—The following notice appears in the *Daily Telegraph* of Wednesday:—In the High Court of Justice.—In Bankruptcy.—In the matter of a bankruptcy notice, dated the 23rd day of June, 1898.—To Edmond Savory D'Odiardi, of 30, Silver Street, and 24, Kensington Park Road, Notting Hill Gate, both in the County of Middlesex, medical electrician: Take notice, that a bankruptcy notice has been issued against you in this Court at the instance of Maud Wood, of 7, Berners Road, Wood Green, in the County of Middlesex, spinster, and the Court has ordered that the publication of this notice in the *London Gazette* and in the *Daily Telegraph* newspapers shall be deemed to be service of the bankruptcy notice upon you. The bankruptcy notice can be inspected by you on application at this Court.

Dated 4th day of July, 1898. H. S. Giffard, Registrar.
Baillie & Co., 15, George Street, Mansion House, E.C.
Solicitors for Judgment Creditor.

Outing.—The employés of the London Electrical Fittings Co. (late A. & W. Hopkins) held their annual beanfeast at Bourne End on the 2nd inst. The party, which was a large one, spent a very enjoyable day, dinner and sports being provided by the firm. We understand this firm is extremely full of orders and is contemplating an enlargement of the works.

Charge of Theft.—At the St. Augustine's (Canterbury) Petty Sessions on Saturday last, Edmund Parsons was fined £5, including costs, for stealing small sums of money from the telephone company. It appeared that the defendant was foreman ganger, and on various occasions he got the men under him to sign for more money than they received. The defence was that the differences in the sums were to cover out-of-pocket expenses, and this was corroborated by a previous manager, who said the company's rules did not recognise expenses incurred under the foreman's name, and this was the only way a foreman could recoup himself.

Electrical Engineering in Italy.—Another new company has just been formed in Milan, under the auspices of the Continental Gesellschaft für Electrische Unternehmungen and Messrs. Schuckert & Co., Nuremburg, to promote and finance electrical undertakings in Italy. The title of the company is La Società Nazionale per Industrie ed Imprese Elettrichi, and the capital is £200,000.

Evered & Co.—Messrs. Evered & Co., of London and Birmingham, have just issued a new edition of their catalogue of electric light fittings consisting of a handsome volume, well printed, and strongly bound. In some respects it will be found to differ from

many of the best known trade lists. In the first place it is strictly confined to fittings, the usual descriptions and prices of accessories being altogether omitted as being practically of no assistance to those who buy. Then, again, the compilers have neither gone to the unnecessary expense of printing the whole catalogue in the highest style of the art, nor, on the other hand, have they spared any outlay on the parts demanding special treatment in order to convey to the mind the clearest possible idea of the object represented. Thus the first part of the catalogue consists of illustrations, particulars, and prices of what may be called the general run of fittings, or brass goods, consisting of a selection of the patterns generally made by the firm. This section is printed in a distinctive colour on tinted paper. Another section, dealing with wrought-iron work, is printed in another tint on white paper, the illustrations comprising every variety of fitting and a comprehensive range of designs. But it is not till the Special Section of the book is reached that the distinctive character of the catalogue is appreciated. Here the more costly styles of fittings, such as the Louis XV., Louis XVI., and other French and antique types are dealt with in a way worthy of their intrinsic and artistic value. They are represented on a fairly large scale and are carefully printed in blue tint on white paper. Figure stands are dealt with in the same way, a whole page being devoted to each of the more important subjects. Another section consisting of patterns of silk shades is also delicately printed in tint giving an excellent idea of the material illustrated. Altogether the book is one that should be found by the trade to be a valuable aid to cultivating business.

General Power Distributing Company's Bill.—Last week, for the consideration of clauses, the Earl of Northbrook again presided over the Select Committee of the House of Lords, which on Tuesday passed the preamble of the Bill promoted by the General Power Distributing Company. It will be remembered that the Committee required the insertion of clauses limiting the period for the construction of the works at the main station, to show that the company were *bonâ fide* dealing with the district, and also a clause empowering the Board of Trade to revise the company's charges when appealed to after a certain period. The following clause was considered and adopted by the committee:—"That if the company have not, within five years, obtained the certificate and shall not have proved to the satisfaction of the Board of Trade that they have expended the sum of £50,000 on the undertaking, the powers granted by this Act shall cease and determine." With regard to supplying electricity in bulk, the clause submitted to the committee on Tuesday was reconstructed and passed in the following form.—"The following provisions shall not apply, except so far as may be agreed to the contrary, between the company and the Corporation of any borough which at the time of the passing of this Act shall be supplying electrical energy, or have obtained an order or Act empowering such Corporation to supply electrical energy. The company shall, six calendar months before commencing to distribute electrical energy within any such borough, give notice in writing of their desire so to do to the Corporation, and the Corporation shall, within three months after receiving such notice, be entitled to serve upon the company a counter-notice indicating their desire to undertake such distribution themselves, and to purchase from the company a supply in bulk. The terms of such supply in bulk, as to price, minimum amount, and all other details, shall, failing agreement between the company and the Corporation, be determined by an arbitrator." On the question of maximum price, the Committee decided that this should be 4d. per Board of Trade unit for large and 2d. per unit for small consumers, with the proviso that if the average charge in any one year is not more than 3½d. per unit, the company may divide 10 per cent, if they earn it, and with any lowering of the average an increased dividend.

Improved Boiler Setting.—We have received from the Patent Locking Joint Boiler Setting Company, of Reading, a coloured plan of their system applied to the Lancashire boiler: it consists of the usual setting as approved by the boiler insurance companies, but with the rest faces of the seating blocks rounded so as to reduce the covered portion of the plates to a mere line, and the various other blocks are moulded with special locking joints both in side flues, chimney lining. The object sought is solidity of structure, fullest inspection and a maximum heating surface with a minimum of heat radiation loss. We believe that the system has the approval of the boiler insurance companies.

Messrs. Salmony & Co., Limited.—We are informed that one of the directors of this company has just returned to England after a most successful trip in America. He has been favoured with a representation for Great Britain and the Colonies of several leading firms of the United States, full particulars of which will be shortly announced.

Personal.—Mr. Walter P. Hudson, who has been connected with Messrs. Ferranti, Limited, for some years, was last Saturday entertained at dinner by his friends on the staff on the occasion of his leaving the firm.

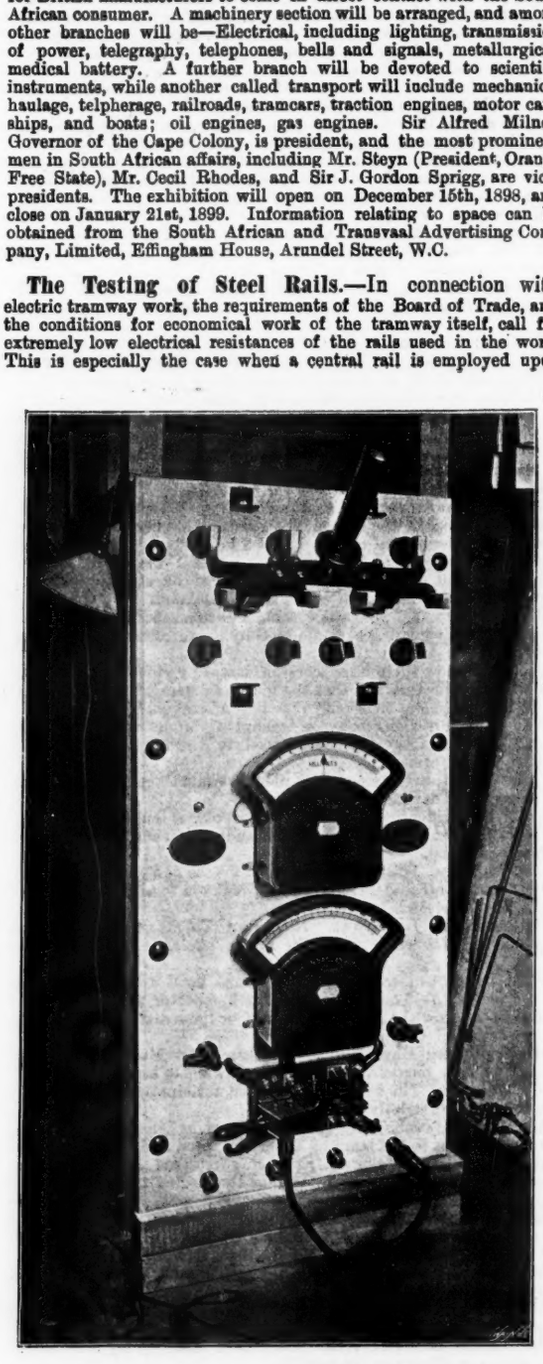
The Press Bazaar.—The Press Bazaar, which created so much sensation during its brief existence, has resulted in a very considerable sum of money (over £10,000) being raised for the benefit of the London Hospital. The feature of the bazaar was undoubtedly the publication of the *Press Bazaar News*, a four-paged paper set up on a brand new aluminium Linotype machine, which, like the Cropper press on which the paper was printed, was run by dynamos. The editorial staff was the most celebrated ever brought together on any paper, and the managing editor was ably assisted by several Yost machines and operators.

Removal.—Messrs. E. P. Allam & Co. have removed from 14, Hatton Garden to 11, Hatton Garden, E.C. (Holborn end).

Sherborne Park.—The extensions of the electric light installation, put down for Lord Sherborne some years ago, have been entrusted to Messrs. Drake & Gorham. As there is an abundant water supply and storage from two lakes having an area of about 15 acres, they are putting in a turbine situated about a quarter of a mile from the house, which is driving a dynamo connected up to the existing supply mains. 120 lights are being added to the installation, and a new "D.P." storage battery is being put in to supply these extra lights, making two separate installations so arranged that a steam engine or the turbine plant can charge either battery.

A South African Exhibition.—The Grahamstown (South Africa) Exhibition of Industries and Fine Arts, which is to be held December, 1898, and January, 1899, will provide an opportunity for British manufacturers to come in direct contact with the South African consumer. A machinery section will be arranged, and among other branches will be—Electrical, including lighting, transmission of power, telegraphy, telephones, bells and signals, metallurgical, medical battery. A further branch will be devoted to scientific instruments, while another called transport will include mechanical haulage, telpherage, railroads, tramcars, traction engines, motor cars, ships, and boats; oil engines, gas engines. Sir Alfred Milner, Governor of the Cape Colony, is president, and the most prominent men in South African affairs, including Mr. Steyn (President, Orange Free State), Mr. Cecil Rhodes, and Sir J. Gordon Sprigg, are vice-presidents. The exhibition will open on December 15th, 1898, and close on January 21st, 1899. Information relating to space can be obtained from the South African and Transvaal Advertising Company, Limited, Effingham House, Arundel Street, W.C.

The Testing of Steel Rails.—In connection with electric tramway work, the requirements of the Board of Trade, and the conditions for economical work of the tramway itself, call for extremely low electrical resistances of the rails used in the work. This is especially the case when a central rail is employed upon



which a contact carried on the locomotive runs; the large wear and tear on the surface of this rail prohibiting the use of copper. The question, therefore, of high conductivity steel rails of all sections, is therefore assuming very great importance, and the demand for these immediately necessitates the construction of apparatus whereby the resistance of the rails themselves can be taken under actual working

conditions. Inasmuch as electrical tests have no permanent effect upon the quality, nature, or strength of the material of which they are made, the rail itself can be used, and not merely a cutting or strip, as in the case of tensile strain tests on boiler plates and similar material. In the case of conductivity of steel rails, the problem is simply one of correct measurement of extremely low resistances in an expeditious manner. Apparatus of this kind has lately been devised by Messrs. Elliott Brothers, and installed in the works of the North Eastern Steel Company, of Middlesbrough, for tests in connection with this class of work which they have in hand. The apparatus was designed so that very little attention is necessary. The rails require no special handling, and the results can be obtained in the smallest possible amount of time. The rails, which in this particular case, weigh about 10 cwt. each, are brought up on a truck and slid off on to a pair of steel rails fixed at a definite distance apart. A considerable number of lengths can be laid down and tested one after the other. As each rail is tested it is laid across two steel knife edges a definite distance apart, and two cables are connected to the rail outside these knife edges by means of clamps. This part of the work can, of course, be done by the ordinary labourers employed about the yard. The method consists in the correct measurement of the total current furnished by a few accumulator cells, and passing through the cable and necessary regulating switches and rheostats through the part of the length of rail under test, and the observation, by means of another instrument, of the exact difference of potential existing between the knife edges upon which the rail under test is laid. These two measurements immediately give the value of the resistance in ohms of the section of rail between the knife edges, which is really all that is required. By using instruments of the Weston type, their dead-beat character enables the readings to be taken almost instantaneously, and with great accuracy; by plotting out a suitable diagram giving a range of resistances in terms of current and difference of potential values, the results can be worked out in ohms, without any calculation at all, and the actual conductivity of the rail determined in terms of a square inch section of pure copper, or any other specified value. Of course, the resistance itself dealt with is extremely small, possibly only one or two $\frac{1}{10000}$ of an ohm. But by means of the method briefly described above, tests are being obtained perfectly consistent, and capable of being repeated time after time with exact coincidence on the same samples. The illustration shows the arrangement of the instruments upon a panel for the complete outfit. The whole arrangement is very simple, and possibly deserves attention chiefly from the fact that it has been worked out in a very practical manner, suitable for dealing with a large number of pieces of the actual manufacture itself, under the conditions existent in an ordinary rolling mill.

Westminster Engineering Company, Limited.—On Saturday last the employés of the Westminster Engineering Company, Limited, had their annual excursion, and the splendid weather and genial company contributed to a very enjoyable day. Reaching Windsor by train about 9 a.m., boating was indulged in until dinner, which was served at the South Western Hotel. Mr. Girdlestone, the managing director, presided at the dinner, and the whole party afterwards drove through Windsor Park, Virginia Water, Egham, and back to Windsor. We understand that this company is very busy, and amongst other work, has in hand the dynamos for H.M.S. *Vengeance*, *Implacable*, *Brisk*, *Cossack*, *Mohawk*, and *Surprise*, 14 machines in all, and six spare armatures. The two first ships are first-class battleships, and have each three dynamos of 600 amperes, multipolar type. The company has also in hand the lighting plant for the Bon Marché, Brixton, three sets of engines and dynamos together of 350 B.H.P., and other large private installations, electric lifts, 60 complete sets of gear for electric cabs, submarine mining, and other apparatus for the War Office and telegraph apparatus for the South Western Railway.

The Yost Typewriter.—The Yost typewriter has been awarded a Gold Medal at the Agricultural Show held at Pretoria in April last. This makes a total of 18 gold medals awarded to this machine.

ELECTRIC LIGHTING NOTES.

Altrincham.—At the monthly meeting of the Altrincham Urban District Council, held on Tuesday evening, the tender of the Altrincham Electric Supply, Limited, to light the large hall of the Literary Institute was accepted. The same firm has just completed the electric lighting of St. Margaret's Church, Dunham Massey, near Altrincham, making the fourth in this district within the last two years. The installation has been admirably carried out under the direction of Mr. Fairlie, the company's engineer.

Barking.—The offer of the Municipal Electric Supply Association to purchase the provisional order has been declined by the Urban Council.

Bethnal Green.—There were 14 tenders for the installation of electric lighting at the new infirmary in Palestine Place, presented to the Board of Guardians. Mr. J. Bedford proposed, and Mr. Hicks seconded, that the tender of Messrs. Calvert & Co. for £5,460 for the first scheme, and £5,675 for the second scheme, be accepted. This was the lowest tender. The highest tender was that of the Thames Ironworks, who tendered £6,930 for the first and £6,030 for the second. The tenders are to be reported upon by the Board's electrical engineer.

Buluwayo.—According to a letter in the *Matabele Times*, it appears to be customary in Buluwayo to dispense with casing for electric light wires, the conductors being merely laid along the walls. An electric inspector seems to be badly wanted there.

Camberley.—The Electric Works Company, Limited, give notice of their intention to apply for a provisional order for the electric lighting of the parishes of Frimley, Farnborough, Windlesham, Winkfield, with Ascot.

Cardiff.—At a meeting of the Corporation Electric Lighting Committee held on Monday, Mr. Applebee, electrical engineer, submitted tenders for two new boilers and one 500-horse-power alternator for the electric lighting station. The Committee, after opening the tenders, handed them to Mr. Applebee to summarise and report to the next meeting.

Chelsea.—On Monday the Chelsea Electrical Supply Company's Bill came before a committee of the House of Lords, of which the Earl of Northbrook was chairman. The Bill proposes to give the company power to extend the electrical generating station at Alpha Place, Chelsea. The measure was very strongly opposed by the Chelsea Vestry, Lord Cadogan, the London County Council, the Rev. H. Webb-Peploe, and others. The Committee decided that so far as the Rev. H. Webb-Peploe was concerned it could not entertain any idea of hearing opposition, because it was clearly a matter of compensation pure and simple. Witnesses were called who said that property in the neighbourhood of the present generating station, which had previously been appreciating in value, had not improved, the price obtainable having remained stationary since the company's works had been established. If they were to be increased, then matters were likely to become worse. The causes of this were that as the result of the station being erected in Alpha Place there was great vibration in the locality; windows shook and plaster fell from the ceilings, while, when the wind was in a certain position, a fine, impalpable ash was blown over the neighbourhood from the smoke-stack of the station.

Cheltenham.—The Town Council on Monday decided to ask the sanction of the Local Government Board to a loan of £28,000 for electric lighting extensions.

Chorley and Whiston.—The preambles of provisional orders promoted by the rural district authorities of these places have been passed by a Lords' Committee.

Clacton-on-Sea.—Regarding the notice of the Coast Development Company that they are about to apply to the Board of Trade for powers to serve the district with the electric light, it has been resolved by the Walton District Council that the scheme has its general approval.

Darlington.—Prof. Kennedy, reporting on the installation of the electric light, suggests certain streets in which mains should be laid. The system is to be the continuous current, three-wire. The cost for 7,000 lamps would be about £22,000, but a smaller scheme of 5,000 lamps would cost £19,000. He estimated that the £22,000 installation could be worked at a profit of over £325 in the second year at least. The power could be used for driving the trams, and he suggests that the High Row and Market Place should be lighted by eight arc lamps.

Douglas.—It is stated in the local press that Prof. Fleming recommends a system of electric lighting for Douglas, the plant for which will cost about £25,000, and when the cost of land is brought in, about £30,000. This plant, it is calculated, would be equal to lighting the whole town; but the area recommended in the first instance includes only the bay front from Strathallan to the Peveril Hotel; Victoria Street, Prospect Hill, and Athol Street; Duke Street, Strand Street, Castle Street, and Broadway.

Dover.—It has been decided to have the Sea Front illuminated with festoons of electric lights from the middle of July to the end of September, the terms of the Electricity Company being £45 for installation and maintenance, and £20 per week for 14 hours' lighting; extra hours, £1 10s. a week.

Edinburgh.—At the recent meeting of the Municipal and County Engineers, Mr. Frank A. Newington, electrical engineer to the Edinburgh Corporation, read a paper on the "Electric Lighting of the City," in which he described in detail the system which had been introduced since May, 1894. There were now, he said, 608 arc lamps for public lighting, to which 130 were to be added, and there were in May last 1,630 consumers, with 149,480 8-candle-power lamps, and 556 street arc lamps. During the past 12 months an average of more than 1,100 8-candle-power lamps had been connected to the mains each week, and applications for a further 15,000 8-candle-power lamps had been received. The price in 1895 was 6d. per lighting unit, and 3½d. for power and heating. At present the charges were respectively 3½d. and 1½d. The total cost per unit sold in 1896-97 was 1·13d. The charge for public lighting had been reduced annually from £20 to £14 per lamp. The capital expended on the undertaking now amounted to about £282,000. Over £8,000 had been set aside in a reserve fund, and there was an estimated surplus this year of between £2,000 and £3,000—a somewhat smaller sum than that of previous years. The growth of the undertaking had been extremely rapid, and the results very satisfactory. This, he thought, had been largely due to the policy which the Corporation had adopted of extending the supply mains wherever there had been a demand for

electric energy, and reducing the price per unit as quickly as possible. In the discussion that followed, Mr. J. P. Barber, Islington, wished that in his parish they could show such good results as they did in Edinburgh. They distinctly showed the advisability of such undertakings being in the hands of the municipality. Mr. Lemon remarked on the extreme cheapness of the public lighting in Edinburgh. Mr. J. Lobley, Hanley, said that all the electric lighting municipalities of the kingdom regarded Edinburgh with mingled feelings of envy and encouragement.

Edmundsons' Electricity Corporation, Limited.—The following notes of central station work at present being carried out by this corporation will be of interest to our readers:—

Winchester.—Provisional order transferred from the corporation to a local company. Works completed and opened for supply last week. (See our description in current issue).

Salisbury.—Provisional order obtained by local company. The works are sufficiently near completion to enable supply to be commenced last month. The station is situated at the Old Town Mills, and about 60 horse-power is available from the water supply, which will be used for charging the accumulators, in addition to the usual steam plant. The system is low tension, three-wire, at 420 volts.

Folkestone.—Electric lighting powers transferred to local company from the corporation. Electric light station being erected at Shorncliffe, about a mile from the centre of the town, capable of supplying 15,000 lights to start with. The works are approaching completion, and a temporary supply is already being given to a number of hotels and private houses. About 60 arc lights are being taken by the authorities for lighting the Leas and principal streets. Three-wire low tension system, 420 volts, is employed.

Bromley (Kent).—Electric lighting powers transferred to local company by the District Council. A station, capable of supplying 10,000 lights, is being erected in the centre of the town, and will be ready for a public supply during the autumn. Low tension three-wire system, 420 volts, is being adopted, but high tension plant, 2,000 volts continuous current, is also being put down, in order to supply a sub-station at Chislehurst, distant about three miles from the works at Bromley.

Chislehurst.—Provisional order obtained by local company, who have made arrangements for supply of current in bulk from the Bromley company. A sub-transformer station is being erected in the village of Chislehurst. Motor transformers to transform from 2,000 volts to 420 volts for distribution on the three-wire low tension system in connection with large accumulators. A supply will be ready for use during the coming autumn.

High Wycombe.—Electric lighting powers transferred from the corporation to a local company. Works for supplying about 5,000 lights are nearly completed, and the supply will be commenced during the present month. The whole of the streets are to be lighted with arc and incandescent lamps, under a contract with the corporation. Three-wire, 420 volts, low tension system.

Newmarket.—Electric lighting powers transferred from local company to private company. Works are just being commenced, capable of supplying about 4,000 lights to start with, and a supply is also expected to be taken to the village of Exning, distant about two miles. A supply of current will be ready in November; 420 volts, three-wire low tension system.

Ventnor.—Electric lighting powers transferred by the local company to a private company. Works are being erected close to the railway station for a supply of about 4,000 lights; the supply will be ready for the coming winter. The principal streets to be lighted with arc and incandescent lights; 420 volts, three-wire system.

Alderley Edge.—Electric lighting powers transferred by local company to a private company. Works for supplying about 3,000 lights; 420 volts, three-wire system.

Woolwich.—The high tension system has been in use at Woolwich for several years. Edmundsons are now arranging to re-construct the station, changing the system to low tension; 420 volts, three-wire. About 4,000 lights at present installed; the mains are to be largely extended.

Montrose.—An agreement has been made with the Town Council to transfer their electric lighting powers to a private company, and works will be commenced very shortly.

Brechin.—Here also an agreement has been made with the corporation to transfer their electric lighting powers to a private company, and the works will be commenced very shortly.

Guernsey.—A Bill has been carried through the States of Guernsey granting Edmundsons' Electricity Corporation the concession for electric lighting in the Island of Guernsey, and a station will shortly be erected at St. Peterport to supply about 5,000 lights on a low tension system.

Electric Lighting at Balmoral Castle.—The arrangements for lighting Balmoral Castle by electricity, says the *Times*, are now being carried into effect, and during her Majesty's recent stay there considerable progress was made with the estate work in connection therewith. Half a mile of iron pipes of large diameter has been laid for bringing the water from the upper portion of the Gelderburn to the site of the turbine house, which is situated near the old sawmill, about a mile and a quarter from the Castle. In some places ways 12 feet deep had to be blasted through the rock for laying the pipes. Provision is being made for two Gilkes vortex turbines, which, with a fall of nearly 80 feet, will give 80 H.P. combined. This power will be utilised in driving the dynamos for charging a large battery of accumulators at the Castle, and also for lighting the lamps direct. The current will be transmitted by large cables laid underground all the way. The electric light will at first be limited to the Queen's private apartments, the ball room, and a few of the principal rooms in the Castle, and the installation is expected to be in working order by the time her Majesty returns to the North next month. Eventually more than 600 lights will be installed in the Castle alone, but if the electric lighting is extended to the stables and outbuildings about 1,000 lights will be required. The whole of the work, with the exception of fixing the turbines, is being carried out by the commissioners' staff at Balmoral, assisted by some of the household electricians, under the direction of Mr. William Massey, of Twyford.

Enfield.—At the last meeting of the Enfield District Council (which has control over an area of 40 square miles) formal notices were read from the Urban Electric Supply Company, the North London Electric Company, and the Electrical Power Distribution Company, giving intimation of their intention to severally apply for a provisional order for electric lighting in Enfield. A lengthy discussion ensued, in the course of which several members urged that sooner than trading companies should obtain powers over the district, the Council should go for the order itself; and eventually a Committee was appointed to investigate and report.

Exeter.—Mr. W. A. Ducat recently held a Local Government Board inquiry regarding the application of the town to borrow £7,000 for electric lighting purposes. Objections were raised on behalf of ratepayers on the grounds that to erect new machinery in the present works was a waste of money, because they were unsuitable for future development. Mr. E. D. Munro, the borough electrical engineer, expressed the opinion that the present works would meet the requirements of the city for many years to come.

Falmouth.—The Falmouth Hotel is to be lighted throughout, and the installation will comprise about 400 incandescent lamps, the plant being driven by a 25 brake horse-power gas engine. The work has been entrusted to Messrs. Veale & Co., Limited, electrical engineers, of St. Austell and Plymouth.

Grimsby.—Prof. Kennedy's report on the question of electric lighting has been received and considered by the sub-committee responsible for the carrying out of the arrangements. There will be another interview with the professor, after which the complete scheme will be brought before the Council. The negotiations with the tramways company as to the supply of electrical power for the cars are said to be proceeding satisfactorily.

Ilfracombe.—The provisional electric lighting order has received the Royal assent.

Ipswich.—The resolution passed at a previous meeting of the Board of Guardians to adopt electric lighting for the workhouse has been re-affirmed.

Isle of Thanet.—The Isle of Thanet Rural District Council have received notification from the London and Provincial Brush Electric Lighting Company of their intention to apply in December next for a provisional order empowering them to supply electric light within the area under the jurisdiction of the Council. The communication has been referred to the Westgate Parochial Committee.

Islington.—After a long discussion at its last meeting, the Vestry sanctioned an expenditure of £192 for fitting the boiler furnaces at the electric light station with smoke-consuming devices, with a view to the prevention of the smoke nuisance. Mr. W. F. Dewey, clerk to the Vestry, read a letter intimating that the Metropolitan Electric Supply Company intended to apply to the Board of Trade for an electric lighting provisional order for Islington. He said that the application was made by the company which had recently been defeated in Marylebone, and apparently the intention was to take revenge in Islington. He thought as the Vestry would refuse to give its consent to the proposed order, that that would be sufficient to scotch the application at once. The letter was referred to the Parliamentary and General Purposes Committee, with instructions to oppose.

Kensington.—It was reported at a recent meeting of the Vestry that letters had been received from the Notting Hill and County of London Electric Lighting Companies, notifying their intention to apply for provisional orders to supply electric light to the parish of Kensington. Both letters were referred to the Special Committee appointed to inquire into the question of electric lighting.

Lancaster.—The electric light will shortly be installed in the fine old parish church of St. Mary's, at Lancaster. At the present time, the only churches in Lancaster lighted by electricity are St. Peter's, Dale Street Mission, and the Baptist Chapel. At a meeting of the congregation of the Centenary Congregational Church, Stonewell, the desirability of introducing electric light was discussed, and a sub-committee was appointed to arrange for the installation of electricity; or, if they found it to be preferable, to call another meeting to consider whether the new electroid gas (?) should substitute ordinary gas.

Limerick.—The Electric Lighting Company of Limerick have obtained from the Shannon Commissioners a site in Athlone, adjoining the Shannon, with the intention of prosecuting business here. From this centre it is intended to supply Ballinasloe, Roscommon, Tullamore, and all the adjoining towns with electric light. They will also supply motive power for manufacturing and general commercial purposes. The company, it will be remembered, are receiving considerable opposition from the Fishery Conservators at Limerick, but it is believed that the obstacles in their way will be eventually surmounted.

London.—In December last the Charing Cross and Strand Electricity Supply Corporation applied to the Corporation of the City of London for permission to apply for a provisional order. That application has been supplemented by a circular letter to the City Corporation, in which it is stated, among other things, that the proposal would be to supply electric energy at the following rates:—(1) For lighting purposes at 5d. per Board of Trade unit, raducible on a sliding scale, according to consumption per lamp, to 4d., and during certain hours, a further reduction for motive power on a sliding scale from 3d. per Board of Trade unit to 2d., according to the times and duration of user of energy. (2) To distribute a low pressure continuous current. They also draw attention to the fact that, for the year 1897, the rates of the several corporations mentioned in Mr. Brooke-Hitching's circular letter, with the sole exception of Brighton, are considerably in excess of theirs, the average rate of Southampton being 6·20d., *i.e.* + 39 per cent.; in Liverpool, 6·03d., *i.e.* + 35·2 per cent.; in Birmingham, 5·28d., *i.e.* + 18·39 per cent.; and Manchester, 4·63d., *i.e.* + 3·81 per cent.; and in Brighton, 3·77d., *i.e.* + 18·3 per cent. They urge that it would be a great advantage to the consumer to have, not only a choice of two systems of supply, but to be able to rely upon the service of one company in the event of accident to the plant or machinery of the other. In the event of obtaining a provisional order, they would, when required to do so, be prepared to undertake public lighting at the prices at present charged to the Corporation. It is suggested that, if they did obtain an order, the result would be either an amalgamation or, at any rate, some agreement with the City of London Company, which would restrict free competition. They remark that they have competed vigorously and successfully with two powerful companies in the areas supplied by them for the past nine years, and never had, nor do they intend to have, any such agreement.

The Brixton Bon Marché has recently been considerably extended, and the contract for the electric light wiring of the whole building has been entrusted to Messrs. Geipel & Lange, to be carried out to the specification of Mr. Albion Snell with Andrews's patent concentric wiring. This system of wiring is being adopted in many other important works, and, among others, is being used throughout the new factory of Messrs. Fullers, Limited, at Hammersmith, where the contract for the lighting and supply of power is also in the hands of Messrs. Geipel & Lange.

Manchester.—The Electricity Committee have presented the following report of their work for the year ended March 31st, 1898. The report states that the number of consumers at the close of the year was 1,981, being an increase of 400 as compared with the previous year. The total number of lamps connected was: incandescent, 149,176 (of 8 candle-power); arc, 1,399—as compared with 120,142 and 1,172 respectively. There were also 214 motors in use, representing 496 H.P., being an increase on the previous year of 92 motors, equivalent to 279 H.P. The total length of mains now laid is 80,102 yards, or 45 miles 902 yards. The amount of energy measured and accounted for was 3,651,599 units, being 93·11 per cent. of the total generated at the works. The financial results of the year had been satisfactory. The net profit, after defraying all charges for cost of production, &c., providing for renewals, sinking fund, and interest on loans, amounted to £13,522 17s. 4d. On September 30th last the price of electric energy was reduced from 6d. to 5d. per unit consumed, and the fixed charge to long-hour consumers was reduced from £9 to £7 per annum per unit of demand. The long-continued dispute in the engineering trade during the later months of 1897 impeded the construction of a large combined engine and dynamo (of 2,500 H.P.) which had been ordered from the Electric Construction Company, Limited, for delivery at Dickinson Street station in October last, and the Committee were reluctantly compelled to issue a notice to the effect that no new applications for a supply of electric energy could be connected to the mains until the spring of this year. This action, although under the circumstances unavoidable, resulted in a serious loss of revenue to the department, and caused much disappointment to a large number of firms who had wired their premises in readiness for the electric energy. In order to cope with the increasing demand for the supply of electric energy for lighting and motive power, the following extensions of plant had been ordered, and were in course of construction, for the Dickinson Street station, viz.:—Six Lancashire boilers, with mechanical stokers; four tubular boilers, two economisers, and two direct driven electric generators, of 2,500 H.P. each. Progress was also being made with the extension of mains. Preparations were being made to supply electric energy in the districts of Moss Side, Withington, and Levenshulme, during the coming winter. The Committee had recently acquired an eligible plot of land alongside the canal in Stuart Street, Bradford, containing 41,955 square yards, which would be equipped as a generating station in due course; the ultimate capacity of this station would be about 100,000 H.P. In addition, a plot of land in the Polygon, Ardwick, had been purchased, on which it was intended to erect buildings for the storage of cables and various instruments, also for workshops and transformer station. For the purposes of the foregoing and other extensions which were contemplated, further borrowing powers would be necessary, and, in accordance with a resolution of the City Council, application had been made to the Local Government Board for sanction to raise an additional sum of £200,000. May 20th, 1897, marked the commencement of arc lighting in the streets, on which date the electric energy was switched on to the arc lamps in Albert Square, St. Ann's Square, and Piccadilly. In compliance with instructions from the City Council, a considerable number of arc lamps would shortly be erected in many of the principal thoroughfares of the city.

Marylebone.—There appears to be an epidemic of competition in Marylebone, for the London and Provincial Brush Electric Light Company and the Marylebone Electric Supply Company have intimated to the Vestry that they intend to apply for provisional orders.

Morecambe.—Last week the lighting of the town was commenced. The cost of the undertaking is estimated at £40,000. There are at present 68 arc lamps in operation, and the light extends from East View to the Battery Inn, a distance of two miles. There are already more applications from private consumers than the Council will be able to supply, so that further extensions of the plant will be made as soon as possible. There is only one steam dynamo fixed, the other two not having been delivered. There are three sub-stations, where the voltage is reduced and distributed at 220 volts to private consumers, who will be supplied, it is hoped, by the August holidays. The lamps on the Promenade are 22 feet in height, and 43 yards apart.

Morley.—At a meeting of the Morley Town Council on Monday the Town Clerk (Mr. T. Borough Hopkins) read a letter from Mr. Hammond, the Council's consulting electrical engineer, calling attention to a Bill which had been approved by the House of Lords giving power to a company entitled "The General Power Electric Current Distributing Company," to supply electricity over an area of 2,000 square miles, which area included the important city of Sheffield and towns of Rotherham, Doncaster, Chesterfield, &c. The letter thought it was undesirable that such a competing provisional order should be allowed to be put into operation, as it would be inimical to the interests of local authorities who had already put down costly electric lighting plants. The Town Clerk said that he had looked into the matter, and the provisions of the Bill at present only applied to the Midland Counties, and the Council had no *locus standi*. The object of the Bill was to give a company power to supply electric current within the limits of municipal corporations, and to that extent the Bill might be a desirable one. The argument in favour of it was that electricity could be produced very much cheaper if distributed over a large area, the minimum price being 2d. per unit, which was much below the rate at which any corporation had hitherto been able to supply it. A clause was in the Bill enabling corporations within the supply area to have a meter put down and to acquire electricity in bulk if they found it could be supplied cheaper than the corporations could generate it. Under these circumstances, he could not advise the Council to take any steps to oppose the Bill, about which doubtless a good deal could be said both for and against, but he suggested that it be referred to the Electric Lighting Committee. This course was adopted.

Newcastle.—Mr. George Lamb, lamp inspector to the Newcastle Corporation, has presented a report to the Special Committee relative to the Corporation undertaking the provision of electricity. In this he states the number of gas lamps at present lighting the main thoroughfares and the number of electric lamps which would be required to replace them. The number of gas lamps is 909, and at the net annual cost of £2 9s. 2d. per lamp, the total cost is £2,234 12s. 6d. This amount is calculated upon gas at 2s. per 1,000 cubic feet, and maintenance at 18s. per lamp per annum. To replace these gas lamps by electricity 350 arc lamps would be required, ranging from 66 to 77 yards apart. To work out the cost it is assumed that a 10-ampere lamp, equal to 1,000 candle-power, will be adopted. The number of hours the public lamps burn throughout the year is 3,775, and the quantity of current used by each lamp would be 1,246 units. The cost of 350 10-ampere arc lamps for current, carbons, and attendance, burning 3,775 hours, and consuming 1,246 units each per annum, would be:—Current, at 2d. per unit, £3,635 2s. 8d.; at 2½d., £4,400 5s. 6d.

Penistone.—It has been decided by the Board of Guardians to obtain an estimate for lighting the Workhouse by electricity.

Ryde.—A public meeting, convened by the Mayor (Alderman E. Marvin, J.P.), was held on Monday evening in the Town Hall to consider the desirability of adoping the electric light. The Mayor said he had called the meeting in accordance with a promise made at a recent Board of Trade inquiry, in order to give the inhabitants an opportunity of expressing their opinion. It was generally conceded, he said, that the establishment of electricity was of more benefit to a town when controlled by the local authority than by a company. A resolution was submitted, requesting the Town Council before urging the adoption of the electric light for Ryde, to appoint a sub-committee to consider the question and to report as to whether it would be a saving or otherwise to the rates for the Corporation to carry out the proposal, and, in the event of a good company being requested to undertake it, to recommend the safeguards to be inserted in any agreement with the Corporation, and the maximum charge per unit. It was suggested, however, by an old inhabitant, Dr. Barrow, who has several times filled the office of mayor, that the meeting should first express an opinion on the main question, and on his proposal the meeting was found to be unanimously in favour of the adoption of the electric light. The relative advantages of the undertaking being in the hands of the Corporation or of a private company were then discussed, and eventually, on a vote being taken on the original resolution, asking the Council to appoint a special committee, there was a tie, 40 voting for, and 40 against, and the Mayor declining to give a casting vote, the Council is left a free hand. It is considered probable that at an early meeting the municipal body will have a "full dress" debate on the subject.

Shoreditch.—Mr. H. E. Kershaw moved the adoption of the report of the Lighting Committee at the ordinary meeting of the Vestry on Tuesday evening. The Committee announced that they had considered the question of reducing the charge for

electrical energy supplied to the public buildings and to the workhouse and infirmary, and had discussed the subject with Mr. Russell, the chief electrical engineer. The Committee, therefore, recommended that the charge for those purposes should be reduced to an all-round rate of 3½d. per unit. Mr. Kershaw stated that the Committee had thoroughly considered the matter, and that they could very well reduce the rate to that recommended, which was no doubt the lowest in London. The recommendation was adopted. It was further reported by the Lighting Committee that they had considered a report from Messrs. Kincaid, Waller & Manville, the consulting engineers, with reference to the question of increasing the capacity of the present storage battery, which was found to be too small for the increased load. On their recommendation, and that of Mr. Newton Russell, the Committee suggested that the tender of Messrs. Pritchett & Gould should be accepted for the supply of a new battery of a capacity of 400 amperes for six hours, including allowance for, and removal of the existing battery, at the price of £1,062. It was resolved to adopt the Committee's recommendation. Mr. H. Mansfield Robinson, clerk to the Vestry, read a letter from the Metropolitan Electric Supply Company, intimating intention to apply to the Board of Trade for a provisional order for Shoreditch, and a notice from the County of London and Brush Provincial Electric Lighting Company proposing to apply for powers for wayleaves in Shoreditch, so as to carry their mains through the district. On the reading of the letters, Mr. Kershaw obtained the sanction of the Vestry to move a special resolution. He said he was afraid that owing to the recent decision of the House of Commons in the case of Marylebone, which allowed the Vestry to enter into competition with the existing company, the companies contended that the same law would apply to them. The whole difficulty arose out of the report of the Joint Committee on the supply of electrical energy. If the House of Commons were consistent, it would give permission to the company to compete with the Vestry's installation in Shoreditch. He therefore moved that the Vestry Clerk should be authorised to take immediate steps in order to prevent any such powers being granted for Shoreditch. Mr. Winkler remarked that, in the name of free trade, and the interests of the consumer, he should vote against the proposal. The resolution was carried with this single dissentient. The Vestry refused to grant permission to the Lighting Committee to obtain and accept tenders for extending the electric light mains in the Haggerston district without first bringing the matter before the Board.

South Shields.—Among the many improvements and alterations that are being carried out at St. Hilda's Church, St. Helens, electric lighting is to be fitted throughout the edifice, Mr. James T. Dagleas being the contractor.

St. Pancras.—The Electricity and Public Lighting Committee reported at the Vestry meeting on Wednesday that they had had under consideration the question of insuring against accident the workmen in the employ of the department. Several insurance companies had been asked to quote rates, and after considering these and the status of the various offices, the Committee had taken out a cover in the Scottish Employers' Liability Insurance Company at the rate of 12s. 6d. per cent. for workmen and 4s. per cent. for clerks. The report was adopted.

Stockport.—It is stated that the public supply for street lighting will be available at the beginning of November.

Stourbridge.—The Board of Trade have granted Kingswinford Rural Council a provisional order for electric lighting in their district, subject to the confirmation of Parliament, and it is stated that the Midland Electric Corporation for Power Distribution, Limited, have arranged to take up the order.

Taunton.—A special meeting of the Council was held last week. The Electric Lighting Committee recommended the acceptance of a tender, amounting to £4,456 16s. 2d., for the carrying out of certain work, subject to the sanction of the Local Government Board to the proposed loan of £11,500, but with power for the Committee to arrange with the tenderers to at once carry out urgent works included in the tender, and also for the Committee to proceed with the sub-station and a portion of the mains to supply the Staplegrove and Rowbarton districts, the whole of such urgent works amounting to about £3,000. The Committee also recommended the acceptance of a tender, amounting to £1,525, for electric arc lighting. Both recommendations were adopted.

Wednesbury.—The General Purposes Committee recommended that Clause 5 of the agreement with the Midland Electrical Company be altered to give the company liberty to proceed with their works as soon as they get in order, and that the Committee accordingly recommend the Council to consent to the grant of the order under the title of "the Midland Electrical Power Distribution and Lighting Order, 1898," and this was adopted.

York.—The Electric Lighting Committee in their report presented at last Monday's meeting state as follows:—It is proposed to accept the tender of Messrs. Parker & Sharp, contractors, York, at the sum of £7,174 12s. 4d., for the erection of the electric lighting station. The Committee have had before them the question of adapting the dynamos and instruments for use afterwards for electric traction. The extra cost will be £274, and the Committee ask for instructions of the Council.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accident on the City and Waterloo Railway.—A serious accident occurred last Friday evening on one of the sidings of the Waterloo and City Railway, which resulted in the death of one man and serious injury to his assistant. Some two or three days prior to the accident a train had been run between Waterloo and the City for experimental purposes. According to the daily press, this train was handed over by the contractors, Messrs. Siemens, to the company, and was being run by them. At the same time a number of trains and carriages were standing in an uncompleted state, and being worked upon by the contractors' men. On one siding stood a whole train "packed up" over a pit, and a few feet off was a single carriage. The wheels of the front bogey were removed, and the carriage was tilted up to enable the fitters to work upon it. Between the stationary train and carriage two men, Frederick Farmer and James Moody, were at work drilling holes for fitting the electric motor. The train from the City arrived at Waterloo, and was sent down into the depôt to have its air reservoirs filled. By some unfortunate mistake it crashed into the stationary carriage and hurled it upon the train behind. The two workmen had no warning of the danger, and were crushed between the two carriages. Help was immediately forthcoming, but when the men were extricated Farmer was found to be dead, whilst Moody was so badly crushed that he had to be removed to St. Thomas's Hospital. His right thigh was severely crushed, but after treatment he was able to return home in a cab. The officials are very reticent as to the cause of the accident, but one theory is that the train was sent on to the wrong siding. Another account states that the brake of the train failed to act. Farmer's body was removed to the Lambeth mortuary. He is described as a fitter, 49 years of age, of 5, Longville Road, Newington Butts. Moody is a labourer, of 31, Sydney Road, Stockwell, and is 46 years old.

Barnsley.—Open air meetings have been held to protest against the proposal of the Town Council to grant permission for a private company to establish tramways.

Birkenhead.—The Town Council were to consider last Wednesday a recommendation of the Special Tramways Committee, passed on June 15th, asking that the Parliamentary Committee be empowered to incur all necessary expense, and to obtain, with a view to confirmation in the next session of Parliament, a provisional order or orders authorising the Council to lay down and equip the proposed new electric tramways, particulars of which have already been published.

Cheltenham.—At the last meeting of the Cheltenham Town Council, which was held on July 4th, the following Special Committee was elected to report on letters, applications, &c., regarding a system of electric trams for Cheltenham:—Aldermen G. Norman, J. Drew; Councillors J. C. Cooper, G. H. Mills, C. Hayward, W. A. Baker, Major-General MacDonald, G. O. Bence, J. D. Steel, S. B. Dix and M. Davis. Mr. R. Bickerdike, of Montreal, has offered to build, equip, and operate a system of lines of electric railways on the trolley plan, forming a complete service for the town and suburbs, free of charge, on the following conditions:—(1) That the Council will accord to his company the exclusive right to do so; the Council to select the streets; (2) The speed of the cars to be regulated by the Council; (3) The rate of fares to be mutually arranged, but suggested 2½d. for continuous trip; (4) The company's cars and plant to be free from taxation.

Cradley Heath.—Many of the local authorities are supporting the scheme of the British Electric Traction Company, which has already received the consent of the Light Railway Commissioners for making a light railway in the district of Cradley Heath, and the Amblecote Urban Council have resolved to support the application to the Board of Trade for confirmation of the order.

Dover.—A local paper says: "'You never know' what a town can do till you test it, and most certainly no one knew, and few ventured to hope, that in four weeks during a rather quiet time of the year the Dover trams would carry 148,000 passengers, which has been the case in the last four weeks. That means that the traffic was equal to an average of about four rides during that period for every individual in Dover and district, from the oldest to the youngest."

Dublin.—The application of the Dublin United Tramway Company for an order in Council authorising various extensions and alteration in their system, has been heard before a Judicial Committee of the Privy Council.

Electric Traction in Russia.—La Société de Tramways de Sebastopol is the title of a company which has just been formed at Silessin (Belgium) with a capital of £80,000, to construct and work a central electric lighting station and a system of electric tramways in the town of Sebastopol, South Russia. The Compagnie de Traction et d'Electricité, at whose instance the company has been formed, has contracted to construct and equip the station and tramways for the sum of £60,000.

Electric Traction in the Canaries.—An application has been made for a concession to construct and work an electric tramway on the island of Teneriffe.

(*Continued on page 54.*)

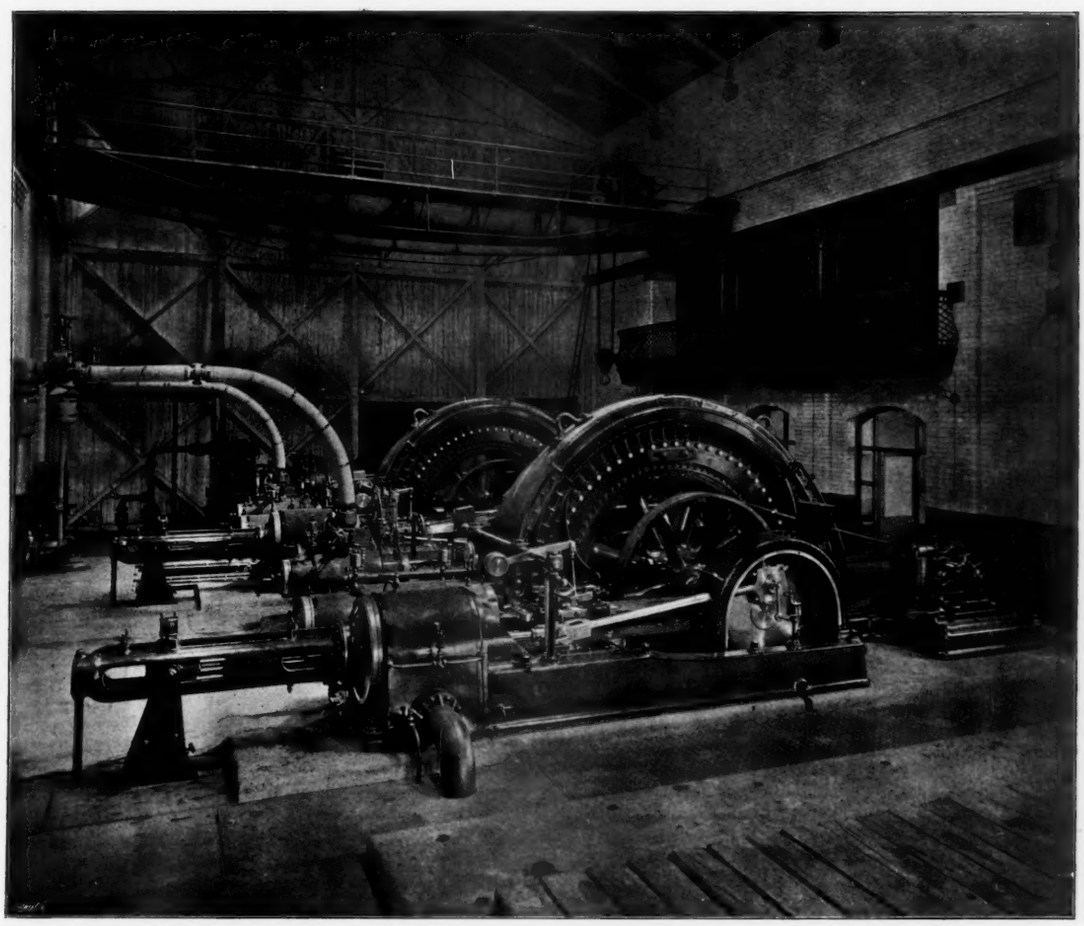
WAKEFIELD CORPORATION ELECTRICITY WORKS.

The Corporation of Wakefield, after being threatened by private companies, appointed in 1893 a sub-committee to consider the desirability of adopting electricity for the city, with powers to investigate and report thereon. The result was a recommendation that the Corporation should immediately apply for a provisional order, and steps were taken with this object. After obtaining the order, Mr. Robert Hammond, M.I.E.E., was authorised to prepare a scheme, and to get out complete plans and specifications and estimates of the works. His instructions were to base his scheme upon the erection of the works on the outskirts of the city on a plot of land about 1¼ miles from the centre of the city, where it was also proposed to erect a dust destructor and sewage works. He recommended the adoption of the single-phase alternating system, with an E.M.F. of 2,000 volts, the electrical energy being brought from the works direct to a sub-station situated in the centre of the city, and there converted to a pressure of 200 volts for distribution. In view of the amended regulations of the Board of Trade, and the satisfactory working of the 200-volt lamp, the distribution is now being carried on at 400 volts on a three-wire system.

Mr. Hammond's scheme was adopted in its entirety, and the contracts were allocated as under :—

	Contractors.
Boiler House Plant.— Two Lancashire boilers, mechanical stokers, economiser, feed pump, injector, and accessories.	Messrs. John Fowler and Co. (Leeds), Ltd.
Engine House Plant. Three 130-kilowatt fly-wheel alternators, one 34-kilowatt day load alternator, condensers, pipework and workshop fittings.	
Switchboard and Instruments	Messrs. John Fowler and Co., Ltd.
Sub station Equipment.— Transformers and boxes	
Mains.— Conduits and cables	British Insulated Wire Co., Limited.
Public Lamps.— Ten arc lamps and posts	Brush Electrical Engineering Co., Limited, London.
Meters.— Shallenberger	Westinghouse Electric Co, Limited, London.
Travelling Crane	Thomas Smith Rodley.

The works are situated at Calder Vale, adjoining the railway. The buildings, which include, in addition to those for the electricity works and engine house, the sewage works and dust destructor, were designed by the city surveyor, Mr. Richard Porter.



General View of Works.

The whole of the engine house is lined inside with glazed bricks, and a dado, 4 feet 6 inches high, in two shades of brown, with a moulded projecting course surmounting it; above this, and to the roof, the walls are faced with cream-coloured glazed bricks; pilasters are provided at regular intervals to support the travelling crane beam rail, under which there are four courses corbelled out, forming a series of bays. The ends of the engine house have at present temporary wood ends, in order that any extensions may be made in both directions, and it may be here mentioned that tenders are now obtained for the extension of the east end, for the purpose of erecting the engine house for the sewage pumps, and these buildings will very shortly be commenced. The engine house is 85 feet long and 42 feet wide, and has a clear space from the floor to the tie rod of the roof of 30 feet.

The boiler house is on the north side of the engine house, being 77 feet long and 51 feet wide, with an outbuilding 21 feet by 11 feet for the feed pump and stoker engine. The

instructions of the Council.

(Continued on page 54.)

boiler house has room for four boilers (two are already fixed) and economiser apparatus.

In addition to the usual offices there is the test room, which is 16 feet by 18 feet, and adjoins the office, is entered from the engine house, and is used for the testing of cables and adjusting meters, &c. The switch room extends over the office and test room on the first floor. A balcony 30 feet long, affording to the engineer in charge a complete view of the engines and machinery.

The water for condensing purposes has been brought by means of pipes from the River Calder 700 yards away, at a capital cost of £2,400, the Corporation have also laid (included in this cost) another set of pipes from the works to the river in order to return the condensed water. A portion of this water is used for the feed water for the boiler. When the engines are working in full, the Corporation will thereby save £190 per annum by using this water instead of taking it from the public mains.

Refuse Destructor.

The tender of Messrs. Manlove, Alliott & Co., Nottingham, was in July, 1896, accepted for the construction and erection of a four-cell refuse destructor, house, and two Babcock & Wilcox boilers. The construction was commenced on July 20th, 1897, and was completed in February of this year, it has for some time been working in a temporary manner, but it has now been put in full working order, and will supply steam at the required pressure to work the engines of the electricity plant as far as possible.

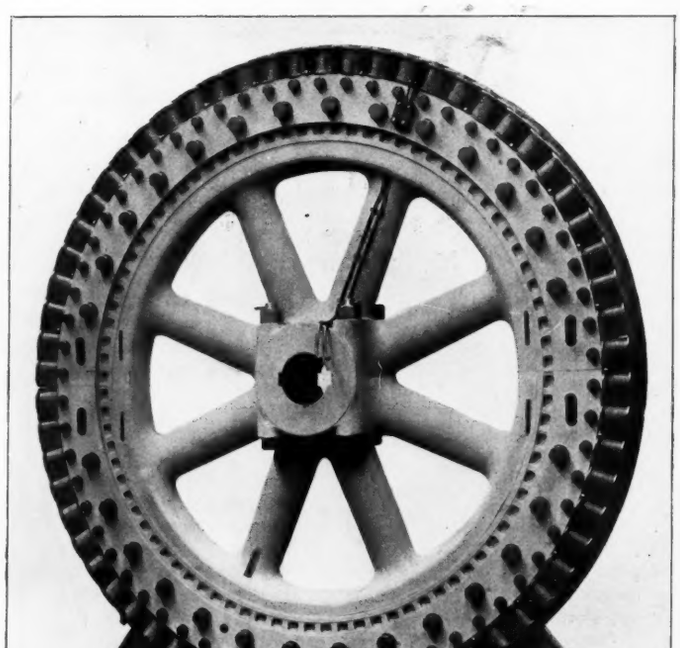
The boiler house at present contains two Lancashire boilers, 30 feet long, built up in six-shell plates ⅞ inch thick, and a diameter of 8 feet, manufactured by Messrs. Spurr, Inman & Co., of Wakefield. Each boiler is capable of evaporating 7,000 lbs. of water per hour when working at 125 lbs. per square inch, with the feed water at a temperature of 60°; they are constructed to work up to 140 lbs. per square inch if necessary. The boiler fittings are of Hopkinson's make. The boilers are fitted with Bennis mechanical stokers. Two Worthington feed pumps are in use, each capable of pumping 30 gallons per minute at a piston speed of 50 feet per minute.

Messrs. Holden & Brooke have supplied the injector, which is designed to work against the maximum pressure of 140 observations per square inch, and is capable of lifting and delivering 1,500 gallons per hour at 125 lbs. pressure. The economiser is by Messrs. Green & Son, and is able to deal continuously with 2,000 lbs. of water per hour.

Engine House.

The principal feature is the slow speed fly-wheel steam alternators. Under the contract, the plant to be erected will comprise:—

Three sets steam alternators of 130 kw. each	...	390 kw.
One set day load plant		34 „
Total capacity		424



Alternator Field Magnets.

At present, two sets of steam alternators are in operation together with the day load plant, while the third steam alternator is at present going through the makers' shops.

The engines of the large plants are of the horizontal compound type, capable of working condensing or non-condensing, the alternator being fixed on the crankshaft, and running at a speed of 112 revolutions per minute. Working condensing, they give a maximum output of 130 kw., with a pressure in the steam chest of 125 lbs. They are fitted with governors, which have proved to be very efficient in ensuring steady running and paralleling, and under the specification the variation of speed, when the load is suddenly switched off or on, should not exceed 5 per cent., and from no load to full load, *i.e.*, 2½ per cent., up and down from the mean. The type of governor which Messrs. Fowler have employed is that of their latest design, viz., the "Marshall" vertical governor, driven by chain band, by means of which a variation as low as 1 per cent. up and down from the mean can be obtained.

The automatic gear fitted on both cylinders is quick and simple in its action, and takes little power, the movement being limited to the raising and lowering of a die in a link.

The pistons are of an improved type, recently invented by one of the firm's engineers, the principle of which is that the piston ring has a spring behind it wound in a corrugated manner, the corrugations being caused by internal bosses, in and out of which the spring is wound. The effect of this is that the flat portion of the spring bearing on the piston ring is always at a sustained definite and constant tension, thus causing the ring which it supports to keep the cylinder uniformly steam-tight. In addition to the spring just described, spiral springs are arranged enclosed in the hollow bosses of one of the rings, but so as to bear firmly on the blank boss of the neighbouring ring, by means of which a spring bearing is obtained in both directions, viz., lengthways and across the barrel of the cylinder, the result being an effective steam joint and a consequent saving in the steam consumption.

Two of the engines are fitted with piston valves, but the third engine is to be supplied with the firm's newest type of positive Corliss valve, together with new automatic expansion gear, which, it is anticipated, will show high results. The valves are arranged directly in the cover of the cylinder itself, so that the clearance is reduced to the smallest possible dimensions. With this is combined the latest form of cut-off gear, with separate steam and exhaust valves, the movement secured by the arrangement being exceedingly small and very rapid, and therefore allowing of application to high speeds.

The valves are arranged in the following manner:—The steam is controlled by the expansion valve working on the back of the main valve. This main valve is driven from a wrist plate connected to the side of the cylinder; this also drives the exhaust as in the ordinary Corliss practice. The expansion valve is driven from a double curved slotted wrist

plate on the opposite side of the cylinder, the travel of the valve being varied by the raising or lowering of the die in the curved slot, as controlled by the governor. The wrist plate takes its movement from the eccentric, to which it is coupled direct.

One jet condenser and air pump is arranged for each engine, the pump being fixed below the floor, and worked off an extension of the low pressure piston rod.

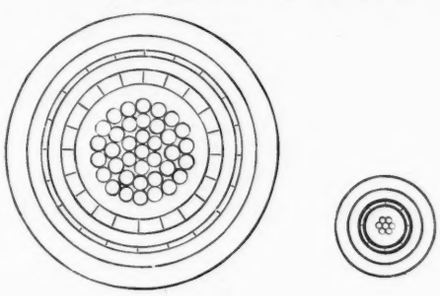
The alternators are made by Messrs. John Fowler & Co., under the Hall patents, and like the engines, embody the latest construction, based upon extended experience in high tension work. Each of the larger alternators is constructed to give an output of 112 kilowatts at a speed of 112 revolutions per minute, and with a periodicity of 60, as an ordinary working load; but on emergency these alternators are guaranteed to be capable of delivering 130 kilowatts for several hours, if necessary. They run with one pole earthed. The field magnets of the alternator form the fly-wheel of the engine, and are placed between the high and low pressure cylinders, the foundation plate of which is arranged to take the alternator armature, which is slot or polar wound.

Alternator Armature.

The machines have a minimum insulation resistance of 50 megohms between the armature and core, and 1 megohm between the magnets and core. The insulation between the armature conductors and the frames is capable of resisting piercing by a spark of 4,000 volts alternating E.M.F.

The machines will repay a careful inspection as to their strong mechanical construction and durability, being made for continuous running and capable of withstanding rough usage.

Since large alternators came into use, it has been found necessary to have them capable of running silently or practically so, as far as annoyance to outside property owners is concerned, and these alternators have been brought up to these requirements by careful study and trial, and should meet the utmost wishes of the fastidious. The machines run continuously in parallel with a low synchronising current, and can be put in parallel with the plant running at full load within two minutes.



37/13 S.W.G. 7/18 S.W.G.

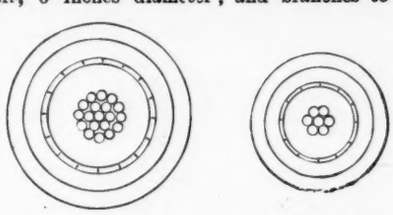
Sections of Low Tension Cable.

In order to provide for inspection and cleaning of the machine, the armature is arranged to rack open by means of a screw rack and gear. Should replacement of coils at any time be necessary, the coils are so constructed that in 10 minutes a new coil can be placed in position, which is no small advantage to the central station engineer. It has, however, been found in actual practice that these machines rarely require any such replacement.

The day load plant consists of a 34-kilowatt alternator, driven by a Belliss vertical high speed enclosed engine, running at 450 revolutions per minute. The alternator is of the same type as the larger machines. A jet condenser is fixed to condense the exhaust steam from the Belliss 50-I.H.P. engine.

The engine house sundries include an automatic waste oil purifier worked by exhaust steam. It requires no chemicals, cloths, charcoal, or other filtering substances, being based upon the relative difference in the specific weights of oil and water. The oil runs through the centre tube below the water, passes round the steam coil, and being thus somewhat diluted, drops the finest of its impurities. After going once more down through the chamber, and again up through it, and once more through water, it finally gathers above the water line ready for use. The blow-off pipe answers as an outlet for any gases that may form. It will also prevent overflowing by discharging any rising or over-heated oil back into the reservoir. The steam pipe serves to thoroughly blow out and clean the whole apparatus from time to time. The purifier is made by Messrs. W. H. Willcox & Co.

The steam pipes are arranged with connections to separate branch pieces on engines and boilers, and consist of lap-welded steel, manufactured by Messrs. Stewart & Clyesdale. The flanges are screwed and brazed. The tees are of cast-iron, and the diameters of the main pipes and principal branches are as follows :—Main, 9 inches diameter; branches to boilers, 6 inches diameter; and branches to engines, 5 inches diameter. The subsidiary steam pipes are of wrought-iron, and connect the feed pump, injectors, condensers, &c., with necessary valves and drains. All the steam pipes are covered with sectional magnesia non-conducting lagging. The exhaust pipes are of cast-iron 18 inches diameter, and are capable of dealing with the exhaust up to 1,000 I.H.P. They are carried underground and con-



19/16 S.W.G. 7/16 S.W.G.

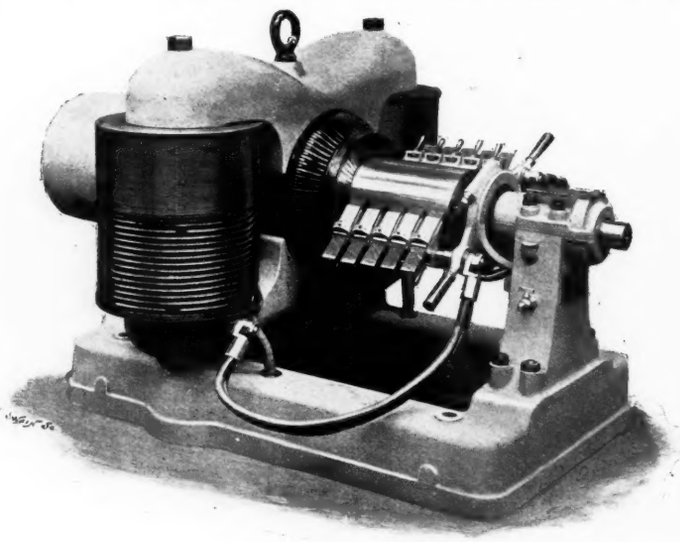
Sections of High Tension Cables.

nected to a single up-take pipe, so that the exhaust steam, in the event of the plant not working condensing, may be delivered into the atmosphere direct. The up-take pipe is carried outside the building, and to a height of 6 feet above the roof. The valves and connections are so arranged as to enable the engines to be worked condensing or non-condensing at will. A system of drain pipes is arranged in the engine room and boiler house. The feed pipes are of cast-iron in duplicate, and of 3-inch bore, and are connected to pump, economiser, and injector. The blow-off pipes and drain are also of 3-inch cast-iron.

Three 8-inch branch pipes connect the in-take pipe with the engine pumps with a sluice valve at the end, the valve spindle being carried up so as to be operated from the floor level. A cast-iron feed water tank is placed underground, the capacity being 3,000 gallons. All the steam and feed valves are of Hopkinson's patent parallel slide pattern.

The switchboard is arranged on the well-known Lowrie-Hall system of plug switches and fuses.

The switch parts and instruments are fixed on an iron framework consisting of H iron uprights fixed top and bottom to channel iron girders, the uprights being drilled for fixing the switch parts, which are all mounted on black enamelled slate slabs. The top is surmounted by an ornamental border in cast-iron bolted to the top channel iron, a clock being fixed in the centre of the board above the moulding enclosed in the ornamental cast-iron frame.



Exciter.

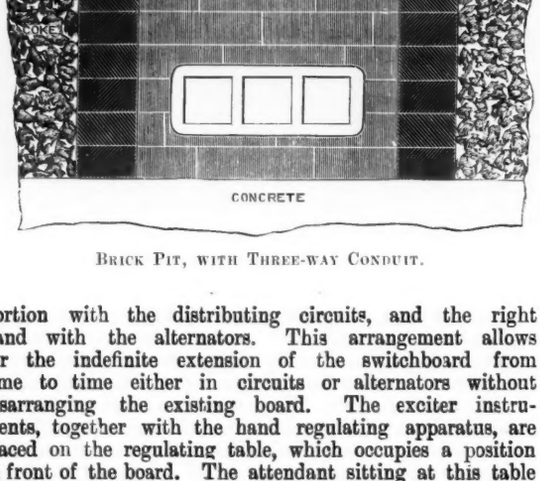
The conductors are brought up to the switch parts at the back of the board through insulated collars fitted in drilled holes in the iron work. The frame work is supported by wrought-iron stays connecting the wall and the uprights, and the whole makes a non-combustible switchboard. The switchboard is divided into three parts, the centre portion dealing with the synchronising instruments, the left hand portion with the distributing circuits, and the right hand with the alternators. This arrangement allows for the indefinite extension of the switchboard from time to time either in circuits or alternators without disarranging the existing board. The exciter instruments, together with the hand regulating apparatus, are placed on the regulating table, which occupies a position in front of the board. The attendant sitting at this table has therefore also a clear view of the switchboard.

Upon the regulating table are also fixed the transmitting portion of the signalling apparatus, consisting of switchboard and lamps connected in series with the engine room indicator. This consists of two cast-iron boxes with ground glass fronts, arranged in separate compartments, each divided off from one another, and each being fitted with a lamp behind the ground glass front. One of the boxes has its divisions marked with the numbers of the engine, the numbers being painted on the ground glass referred to; the other box has the driver's instructions painted on the ground glass, one word for each division, viz., "fast," "slow," "right," "stop." When the signal is desired to be given, an electric bell is sounded, the attendant closes a switch belonging to the particular engine for which the signal is intended; this lights up the lamp immediately over the switch, and also the lamp in the particular compartment of the indicator, whose glass front bears the engine number; he also closes the switch belonging to the particular word of instructions in the other box, and the lamp lights up in the same manner. The driver in the engine room has therefore two illuminated signals, the one giving him the number of the engine which he is to operate, and the other instructing him to go either "fast," "slow," or to "stop."

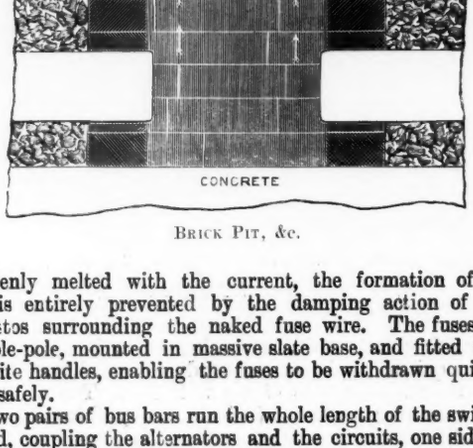
The entire switchboard at present provides for three circuits and four alternators. The connections between the alternators and circuits of the board are made by means of concentric cable, which are connected at the board by special concentric fittings mounted on porcelain, which is again mounted on slate. All the current-carrying metal parts of the high tension apparatus are mounted on porcelain, which in turn is mounted on the enamelled slate, and the high tension switches are surrounded by slate guards to prevent accidental contact.

The main fuses are of the latest type of Lowrie-Hall, made by the addition of the firm's latest patent asbestos sheathed fuse, by means of which, should the wire be suddenly melted with the current, the formation of an arc is entirely prevented by the damping action of the asbestos surrounding the naked fuse wire. The fuses are double-pole, mounted in massive slate base, and fitted with ebonite handles, enabling the fuses to be withdrawn quickly and safely.

Two pairs of bus bars run the whole length of the switchboard, coupling the alternators and the circuits, one side of each pair of bars being earthed. The voltage of the two



Brick Pit, with Three-way Conduit.



Brick Pit, &c.

bus bars is read from two Kelvin high tension voltmeters. In addition to the above voltmeters, the ampere gauges employed are those of Lord Kelvin, manufactured by Messrs. White, of Glasgow.

The testing room is equipped with the usual set of instruments, including a Thomson galvanometer, fixed on a strong pillar to prevent vibration, with a set of shunts, a Post Office bridge and reversing key, and a portable testing set. There is also a portable galvanometer, Kelvin watt balance, 100 Leclanché cells, and a carbon megohm.

In order to provide a means of testing the output of the alternators before running on the load, a water resistance of a new pattern has been constructed by the firm, which admits of the testing being taken without any difficulty. It consists of a heavy cast-iron tank surmounted by a framework carrying the insulated electrode, which is drawn up or down by means of insulated pulleys. Hitherto this form of resistance has given trouble on account of the great amount of heat generated causing a change in resistance, and where the water container has been of wood it has generally fired. These difficulties have been obviated by providing, first, the heavy container mentioned, and combined with this an outlet pipe, by means of which the water could be kept constantly flowing, thus avoiding the heat trouble.

An overhead travelling crane, made by Mr. Thomas Smith of Rodley, spans the engine house. It has a lifting power of 15 tons, and is worked from above.

A start will shortly be made in the lighting of a few of the streets by electricity. Nine arc lamps and posts have been erected by the Brush Electrical Engineering Company, Limited, and these will be fed with alternating current.

THE MAINS.

The cables are throughout manufactured and laid by the British Insulated Wire Company, Limited, of Prescot, and are of their concentric type, insulated with their patent oil impregnated paper insulation, and lead covered.

The cables carrying current, generated at the Calder Vale works to the sub-station in Westgate, have a further covering of jute yarn to serve as a protection against mechanical damage during drawing in. There are three of these cables between the works and the sub-station insulated to work at a pressure of 2,000 volts, the inner core of each being composed of 19 strands of No. 16 S.W.G., having a sectional area of ·062 square inch.

Six-way stoneware casing has been laid the whole way between the works and the sub-station, except in places where the proximity of cellar roofs to the surface necessitated the use of iron pipes. Cast-iron pipes were also used for road crossings, and for leading into the station. Boxes are placed about every 70 yards in the run of the conduits for the purpose of drawing in the high tension feeders. These boxes are rendered with cement, and covered with the British Insulated Wire Company's patent ventilating cover, whereby the conduits are ventilated, and at the same time it is made impossible for any exterior cause, such as a carelessly-dropped match, to cause an explosion. The cover is also so arranged that it is impossible for water to get into the box by way of the ventilating cover.

In addition to the three high tension feeders there is a 7/16 S.W.G. (·023 square inch) high tension concentric main, lead covered, and served with jute yarn drawn into three-way stoneware casing, running from the town sub-station and supplying the Ings Road Board Schools.

There is also a 19/16 S.W.G (·062. square inch) high tension concentric main, similar to the high tension feeders, run from the sub-station in three-way stoneware casing to the Town Hall for supplying the Town Hall and the County Council Buildings.

These high tension cables were all tested between the inner and outer conductors with a pressure of 5,000 volts for a period of 1 hour, and between the outer conductor and lead with a pressure of 2,500 volts for one hour, after laying and jointing.

The current is transformed at the sub-station in Westgate from 2,000 volts down to 200 volts, and is distributed to consumers by lead covered paper insulated triple concentric cables, the conductors of which have a section of ·25 square inch by ·25 square inch by ·1 square inch respectively.

These cables are protected by two steel tapes wound spirally, so as to form a complete metal sheath.

The arc lighting mains are armoured cables, and are connected to transformers in the base of the posts, which transform the current down to the voltage necessary for the lamps.

SUB-STATION.

The main sub-station bears out the modern character of the whole works. It is connected with the generating works by a B.I.W. air space low capacity paper insulated telephone cable, which is drawn into the stoneware casing alongside the high tension feeders.

The fuses at the sub-station are of the massive main station type, and from these the connections pass on to Lowrie-Hall main station switches, and thence to the bus bars, through Hall-Fuller patent high pressure switch fuses to the four 42-kw. Lowrie-Hall transformers.

The switch fuses just referred to have recently been brought out by Messrs. John Fowler & Co., and are considered by the makers to be the best design of this class of material on the market. Asbestos sheathing affords security against the formation or the maintenance of an arc between the poles on breaking the circuit. The whole of this material is mounted on black enamelled slate fixed to a wrought-iron framework, and placed by itself apart from the low pressure board.

The low pressure distributing board is fixed at the opposite side of the sub-station, and is arranged for three-wire distribution and for six out-going circuits. There are two sets of bus bars, each set connected to a pair of two 42-kw. transformers. The low pressure switches connecting the transformers are of the triple-pole laminated lever type, similar to those manufactured by Messrs. Fowler for the Leeds Electric Tramways switchboard, and are of a fine, substantial character, design, and workmanship. The levers in these switches carry their laminated brushes in such a way as to grip the fixed contacts on their outer sides.

The two bus bars are, of course, employed together when the full load is required. This is indicated by the lamps on the synchronising panel which are watched by the attendant, who visits the sub-station about the time of heavy load to see when the bus bars are in parallel, and he then couples the bus bars by means of the same lever pattern as already described. The circuits are connected to the bus bars by means of the Hall-Fuller low pressure switches, arranged for triple pole. All the connections are arranged at the back of the board, the base of which is enamelled slate, as is the case of the high pressure board.

The transformers are the well-known Lowrie-Hall pattern, of which Messrs. Fowler have supplied over 14,000 horse-power.

SUPPLY.

For the past few weeks one of the larger sets of plant has been in operation, and connections have been made to the premises of many of the leading tradesmen and to the palatial buildings recently erected by the West Riding of Yorkshire County Council, as well as to the theatre.

The supply has on all hands given great satisfaction, the steadiness of the light, due, it is claimed by the contractors, to the heavy fly-wheels on the generating plant, being specially noticeable.

The borough electrical engineer is Mr. Brydges, who was formerly at the works of the Yorkshire House-to-House Company.

Rise in the Price of India-Rubber.—A Birmingham paper says a circular has just been issued to the trade, signed by 24 India-rubber firms, which says that, in consequence of the continued advance in the price of the crude material, the firms have advanced their prices for mechanical rubbers a further 10 per cent. It is only some four months since prices were advanced 10 per cent., so that this makes an advance of 20 per cent. since the beginning of the year. The signatories to the circular include practically all the important manufacturers both in England and Scotland. It is difficult to say whether even now prices are at the top, as there is an ever-increasing difficulty in obtaining adequate supplies of crude rubber.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 48.)

Experiments on the Metropolitan.—It has been finally decided by the Metropolitan and District Railway Companies to carry out a series of experiments in electric traction between High Street, Kensington and Earl's Court, with the object of ascertaining which system will be most suitable. It is stated that a sum of £20,000 has been voted for preliminary experiments.

Forthcoming Tramways.—The *City Press* states that schemes for electric tramways between London and Oxford and London and Brighton are shortly to be submitted to the Light Railway Commissioners.

Gillingham.—At the meeting of the Gillingham Urban District Council on Thursday, 30th ult., there was considerable discussion with reference to the Clerk reading a copy of the draft agreement between the Council and the Electric Tramways Company, who are about to lay lines through the district. The company offer to pay to the Council £2,000 towards the High Street improvements. A number of the Council were of opinion that the company should obtain compulsory powers to effect these improvements, arguing that otherwise they might never be carried out. The matter was referred to the tramway promoters for their opinion.

Laxey and Ramsey.—The new line from Laxey to Ramsey, which will make a continuous electric railway from Douglas to Ramsey will, it is said, be ready for traffic this month.

Leeds.—The electric tramway system is to be extended. It has so far only been worked on the Roundhay Road and Kirkstall Road sections of the city, but contracts have now been let which will, it is expected, see the system developed on three other important roads within the next six months.

The tender of Messrs. Greenwood & Batley, Leeds, has been accepted for supplying two additional engines and dynamos of 1,000 H.P. at a cost of £15,586; and Messrs. Dick, Kerr & Co.'s tender for the supply of 50 new electric cars at £468 10s. each has been accepted.

Manchester.—The Manchester Carriage and Tramway Company's Bill sought powers to work the tramways by electricity, but a Lords' Committee has held that the preamble of the Bill is not proved. This was no doubt due to the strenuous opposition of the Manchester and other municipal authorities.

Power Distribution.—In the House of Commons last week, Mr. Ritchie, replying to Mr. Kimber, said that he had seen the report of the Lords and Commons Joint Committee on "Electrical Energy," but not the evidence and proceedings. The report would be carefully considered by the Board of Trade, but legislation would be required to give effect to some of the Committee's recommendations, and he was afraid that the prospect of passing a Bill during the present session was very small.

Sheffield.—Although electricity has not yet been actually introduced on to the municipal tramways, the following figures relating to the last year's operations may be interesting. The receipts during the last 12 months have been £54,084. The "running" expenses and additions to premises and stock during the year amounted to £23,759. Traffic expenses were £8,637, interest and repayments of stock came to £8,060. After all the expenses were met the net surplus was over £13,000, which is about equal to 13 per cent. on the capital expenditure. When last year's profit is added there is a surplus of £20,000 in hand.

Southampton.—Last week the Southampton tramways were formally transferred to the town authorities.

Tees-Side.—Last week, for the first time, the cars in charge of the drivers were tried over the new Middlesbrough, Stockton, and Thornaby Electric Tramway Company's lines from Norton to North Ormesby. It is expected that in the course of a few days the Board of Trade inspection of the system will take place, Middlesbrough Corporation having withdrawn their opposition to the granting of the Government certificate for running powers.

West Bromwich.—An exhaustive report of the sub-committee appointed to inquire into the various systems of traction, has been submitted to the Highway Committee of the West Bromwich Town Council. The committee, taking into consideration the fact that the Corporation have lately obtained a provisional order to generate and supply electricity within the borough, and that the two schemes—viz., electric lighting and tramways—could be worked to the advantage and benefit of the town, recommend the Council to purchase the part of the tramway undertaking within the borough of West Bromwich, on the expiration of the present lease, under the Tramways Act, 1870, and to apply for the necessary powers to equip and work the lines when taken over. They recommend the adoption of the overhead electric traction system.

Winton.—Mr. J. Vincent Kitchener, on behalf of the British Electric Traction Company, attended a meeting of the Parish Council and explained the tramway scheme proposed by his company, which would practically connect Poole with Bournemouth. Eventually the Council passed the following resolution:—"That the Parish Council having by resolution passed at a meeting held on November 4th, 1897, expressed its general approval of the system of electric tramways, are of opinion that the scheme proposed is calculated to serve the best ends of the parish of Winton, and resolves to give their support to the same."

Withington.—The Withington District Council have passed a resolution to purchase from the Manchester Carriage Company the tramways that are in the district, and to promote a Parliamentary Bill for powers to introduce mechanical traction.

TELEGRAPH AND TELEPHONE NOTES.

Cable Connection with Lighthouses.—In the House of Commons last week, in reply to Mr. Broadhurst, Mr. Ritchie said: At the present time three additional lighthouses are in course of being connected with the shore by electric cables. It has been thought better to postpone the work of connecting more lightships pending further results of the experiments with the system of wireless telegraphy. Mr. Broadhurst asked whether the right hon. gentleman could give the names of the lighthouses.—Mr. Ritchie: Godrevy, the Skerries, and Walney Island.

Edinburgh.—A report condemming the present telephone system has been submitted to the members of the Edinburgh Chamber of Commerce, and a resolution approving the report has been adopted.

The Great Northern Telegraph Company, Limited.—On and after July 1st next, the rates by this company's lines will be: To Norway, 3d. per word; to Sweden, 3½d. per word (with a minimum of 10d. per telegram).

Code Messages to the West Indies.—The Direct United States Cable Company, Limited, notifies that the censorship restrictions of the United States War Department upon cipher and code messages have now been removed for all points in the West Indies, excepting the Islands of Cuba, Hayti, and Santa Domingo. Messages in code are therefore again accepted, with the three above-named exceptions, by the usual route, at the ordinary rates.

The Interruptions in Australian Trunk Landlines.—During the Postal and Telegraph Conference recently held at Hobart, the unsatisfactory conditions of the landlines was discussed. The Hon. J. Gavan Duffy, Postmaster-General for Victoria, said that "in his opinion this matter of landlines was of as great importance as that of the marine cables. The great complaint in West Australia, as in Tasmania, was that the landlines were continually breaking down. The landline crossed South Australia, traversing some hundreds of miles through desert country, and was continually breaking down one way or another. What they wanted was that the line between the capitals of Australia should be put in such a state as to render regular and efficient service. He gave the South Australian Government great credit for the Adelaide-Port Darwin line, but then they had paid handsomely for it, and the least they had a right to expect in return was that it should be kept in efficient order. Beside that, they had the cable to Roebuck Bay, but could not make use of it because as soon as the floods came the landline was washed away, so that there was no efficient service in West Australia. What they really wanted in regard to Roebuck Bay was a new landline service through West Australia, not touching the sea coast at all, but running inland, where it was not so liable to damage as was a line skirting the coast. He hoped the Conference would be able to make a suggestion to the Colonies of West Australia, South Australia, and Queensland by which the existing state of affairs could be remedied." The Postmaster-General of New South Wales, the Hon. Joseph Cook said: "Something would have to be done as far as New South Wales was concerned for the simple reason that things could not go on as they were at present. Business was disarranged, and had been for months past, and the great delays caused by landline interruption rendered the marine cable of little use. From a list of delays from December 9th, 1897, to March 8th, 1898, he found no less than 38 specific delays in the cable business. It had become quite a frequent thing to hear of interruptions. Last year there were over 60, but every month they were getting more frequent, and the statement at the head of newspaper columns that the cable was interrupted had become so monotonous and so provocative of bad language and loss of business and money, that it was imperative something must be done." Mr. Cook also said: "Delays during the last six months had averaged 8 or 9 days per month, meaning immense loss to the business public. There was an absolute feeling of irritation and disappointment in Sydney and throughout the whole mercantile community of New South Wales through these vexatious defects in the landline."

Mistaken Generosity.—We find that since the year ending April 30th, 1892, the Australian colonies have paid the sum of £319,237 as contributions to guarantees and subsidies in connection with the landline and cable services. Of this sum the Eastern Extension Telegraph Company has received £249,889 in subsidies and guarantees, an amount which has been paid to this company partly with the object of ensuring an efficient service, and partly with the object of ensuring a decrease in the rates formerly charged for telegrams. In the period above referred to, the total Australian international telegraph business resulted in receipts equal to £2,394,553 and presumably some of this went into the pockets of the subsidised and guaranteed Eastern Extension Telegraph Company. Australia owes but little gratitude to this company, which had to be well paid (£32,400 per annum) to duplicate its faulty lines, and which had again to be financially supported before reducing the very high rates which it exacted some seven or eight years ago. The ad-

vantage accruing to Australia by this reduction has been very great. Since the new rates came into force the amount of annual traffic has almost doubled, and the receipts, in which the company shares, has made an almost corresponding increase; nor is this all, as the decrease in the rate chargeable for telegrams to and from Australia, taken together with the increased volume of traffic, means that in money expended on telegrams alone, to and from Australia, an economy of about £2,000,000 has been made to the public on the amount which they would have paid did the old rate still apply to the present amount of traffic. This does not in any way take into consideration the amount of profitable business which may have accrued through this increased volume of traffic. These advantages would not have been offered by the Eastern Extension Telegraph Company without guarantees from the Governments. This in itself is a strong argument for Government control of such lines.

Post Office and Telephones.—Mr. Hanbury, in the House of Commons, in reply to Mr. Broadhurst, said, apart from the arrangement covered by the agreement between the Postmaster-General and the National Telephone Company of March 25th, 1895, which had been presented to Parliament, it was the practice of the Post Office to refuse permission to the National Telephone Company to take its wires over postal telegraph poles, both on grounds of policy and because such an arrangement would involve divided maintenance, to which there were practical objections.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1898 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Caimanera-Santiago de Cuba }	June 10th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Ceara-Pernambuco	June 28th, 1898 ...	July 2nd, 1898
Maranham-Para	April 17th, 1898 ...	...
Hong Kong-Manila	May 3rd, 1898 ...	...
Loanda-San Thomé ...	June 3rd, 1898 ...	July 2nd, 1898
Lourenço Marques-Durban...	June 30th, 1898 ...	...
LANDLINES.		
Trans-Continental line beyond Masol }	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Saigon-Bangkok	July 2nd, 1898 ...	July 4th, 1898

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—July 11th. Estimates of designs are wanted for the electric lighting of the West Parish Church for the Town Council. Specifications may be seen at the office of the city architect, 224, Union Street, and offers and designs sent in to P. M. Cran, Esq., city chamberlain, Town House.

Belgium.—August 1st. The municipal authorities of Stavelot are inviting tenders until August 1st for the concession for the supply of electrical engines for lighting and power purposes in the town during a period of 30 years. Tenders to be sent to L'Administration Communale de Stavelot (Belgium). Particulars from the Secretariat de la Ville on payment of 4 francs.

Brighton.—July 11th. The Council wants tenders for the supply of unarmoured and armoured lead covered cables for the Corporation electricity works during one year from July 31st. See our "Official Notices" this week for particulars.

Dublin.—July 23rd. The Great Northern Railway Company (Ireland) invite tenders for complete electric lighting installation for the premises at Amiens Street Terminus, Dublin. Specification from the secretary.

Exeter.—July 25th. The Corporation require high and low tension concentric mains, transformers, meters, and a feed water heater. See our "Official Notices."

Melbourne.—Tenders are asked by the Melbourne City Council for 600,000 arc lamp carbons. See our "Official Notices."

Melbourne.—August 16th. The City Council is inviting tenders for the supply and delivery of arc lamp carbons. See our "Official Notices" June 24th.

Middlesbrough.—July 15th. The Tees Union Shipping Company are inviting tenders for the construction and erection of an electrical hoist upon their wharf at Middlesbrough. Particulars, &c., from Mr. J. G. W. Aldridge, 9, Victoria Street, S.W., and tenders to the secretary.

Northwich.—July 14th. The Guardians invite tenders for the electric lighting of their Workhouse. The premises may be viewed, and specification, &c., obtained, upon application to the Master of the Workhouse.

Shanghai.—August 10th. The Shanghai Municipal Council invites tenders for the supply of two 100-kw. direct coupled steam alternators, switchboard, and water-tube boiler. Particulars and specifications to be obtained from Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, E.C., to whom tenders have to be sent. See our "Official Notices" June 24th.

Shoreditch.—July 18th. The Vestry invite tenders for the supply and erection of additional continuous current motor transformers with switch gear and extension to switchboard at the electric generating station, Coronet Street, Shoreditch. Specifications from Messrs. Kincaid, Waller & Manville, 29, Great George Street. See our "Official Notices."

Spain.—The Municipal Authorities of La Carolina (Jaen province) are inviting tenders until July 11th for the concession for the electric lighting of the public streets of the town during a period of 20 years. Tenders to be sent to El Secretario del Ayuntamiento de la Carolina (Jaen), Spain, from whence particulars may be obtained.

St. Mary, Newington.—July 22nd. The Vestry ask for tenders for supply and laying of insulated mains, conduits, boxes, &c. See our "Official Notices."

St. Pancras.—July 12th. The Vestry wants tenders for condensing plant, steam pipes, &c., for the Regent's Park generating station, 47, Stanhope Street, N.W. Particulars from the chief clerk, Electricity Department offices, 57, Pratt Street, N.W. See our "Official Notices" June 24th.

West Ham.—July 18th. The Council invite tenders for the Municipal Technical Institute for battery, two electro-motor experiment dynamos and transformers, machine tools and experimental steam engines. See our "Official Notices."

Yarmouth.—July 19th. The Corporation invite tenders for one 150-kw. high speed engine and alternator direct coupled. Specification from Mr. A. H. Preece, 39, Victoria Street, S.W.

CLOSED.

Edinburgh.—The Electric Lighting Committee recommended the acceptance of the estimate of Messrs. Babcock & Wilcox and Co., Renfrew, for steam and exhaust pipes, the amount being £2,626; and the estimates of Messrs. John Shaw & Co., Glasgow, for cast-iron pipes and collars; and Messrs. R. McLean & Co., Glasgow, for cast-iron service box frame and covers. The recommendations were approved.

NOTES.

The Fire at Manchester Square Station.—From a personal investigation which we made last week, the results of the fire at the Manchester Square station were not quite so disastrous as was at first feared. It is true that the fire caused considerable damage, the roof and various wooden erections being completely destroyed, but the steam pipes were not injured and the only damage sustained by the generators was due to water. The fire occurred at midnight on Monday, and though it was of considerable severity, the cables leaving the switchboard for the streets were practically untouched, and within a very short time nearly the whole of the system was connected to the Amberley Road station. By Tuesday evening the usual load on the Manchester Square station was being met by the Amberley Road Works and the London Electric Supply Corporation; moreover, one of the steam turbines was in fit condition to be used. In addition to the permanent connection existing between Manchester Square and Amberley, the two systems of the Metropolitan Company and the London Company are in connection at Manchester Square, and within a very short period a considerable load can be transferred to the mains of the latter company. A set of regulating transformers are provided to permit of this, the supply of the London Company entering at 2,000 volts, and being distributed by the Metropolitan Company at 1,000 volts or 1,500 as required. The cause of the accident is easily explained, it was in fact due to a momentary act of carelessness or forgetfulness on the part of the switchboard attendant who put in plug switches at the wrong connections. The Metropolitan Company do not parallel their alternators, and the wrong connection had practically the effect of endeavouring to parallel two machines that were out of phase. The result was that an arc was started at the plug connection, and the fire immediately travelled up the board, with the serious results already indicated. The repairs are now well in hand, and probably by this time most of the machinery will be running.

Electricity in Italy.—Attention is drawn by Mr. Consul W. Keene to the future which is opening in Italy for the development of electrical power from water supplies, particularly in Piedmont, which is rich in waterfalls. He thinks that there is here an opportunity for English companies to enter into large contracts for the supply of electricity, and to start establishments for the manufacture of electrical appliances. The use of electricity for lighting, for driving tramways, for running factories, and for various uses, is making rapid strides in Italy. In Genoa and its district alone a great deal has already been done. There are 70 kiloms. of electric tramway in Genoa itself, over which 1,634,000 car kiloms. were run in 1897. The line is metre width, and works on the overhead system. The rails and electric appliances were, we notice with regret, furnished by the Allgemeine Elektricitäts Gesellschaft, of Berlin. At Spezzia the naval dockyards are already lighted by electricity, and a project for lighting the principal streets of the town is now under consideration. At San Remo nearly all the best villas and hotels are lighted by electricity supplied by the Co-operative Electric Lighting Company, and at Ventimiglia electricity has almost entirely superseded gas as an illuminant. Both there and at Bordighera, where it is also making progress, it is supplied by an English company. In Turin electrical industries are rapidly developing, mostly under the guidance of Swiss and German companies associated with Italian houses. It is expected that the complete network of electric tramways in Turin will be open by the time of the National Exhibition, which is to be held this year, and Turin will be then one of the towns in the world best supplied with tramways. From all this it will be seen that there is much support for the Consul's observation; and if financial arrangements were only a little more stable in Italy, the field would indeed be good for English enterprise. But how is it, we may ask, in passing, that German companies manage to get on so well in spite of financial crises?—*Engineer*.

The Cost of Steam and Electricity from Water-Power Compared.—*Industries and Iron* states that C. Saldini has calculated the comparative cost of steam and electrically-transmitted water-power. For the steam engine he includes the following items: (1) Cost of Cardiff coal per B.H.P.; (2) wages, oil; (3) working cost per B.H.P.; (4) interest on capital; (5) amortisation of capital. For engines of 500 and above that number of horse-power he finds that the annual cost per B.H.P. is £4·8 per horse-power. In the case of water-power the following items are taken into consideration: (1) Profits, concessions; (2) hydraulic works and buildings; (3) turbines, tubing, gates; (4) alternating exciters, switchboards, crane reserves; (5) transmission lines, indemnities, poles, copper, buildings, transformers; (6) maintenance and repairs of machinery and line, canal and buildings; (7) management and administration; (8) water-rights and taxes. And he finds that for 10,000 to 12,000 H.P. the cost is £5 per horse-power per annum, and for 500 horse-power £5·3 per horse-power.

A Peculiar Accident.—The *Street Railway Review* states that on May 26th a workman on the South Side Elevated, Chicago, dropped a tool, which made electrical connection between the third rail and a large gas pipe carried on the structure. A hole was burned in the pipe, and the gas ignited. The fire department was called out, and traffic between the down-town terminus and 33rd Street was blocked for over two hours. The wiring in several cars was burned out, and the cars set on fire. A few days previous to this another one of the cars was set on fire by arcing in a portion of the electrical equipment.

Electrical Engineers R.E. (Volunteers).—It has been decided to enrol no more men for this year. As many men as can be dealt with at the first training—which takes place at the Western Defences, Isle of Wight, in July and August—have now joined the Corps. Further applications will, however, be received, and eligible men engaging to enrol may attend a certain number of military drills during September and October, though they cannot be formally enrolled before November 1st, the beginning of the next volunteer year.

The Workmen's Compensation Act.—Whilst almost all engineering firms or users of machinery have, as a matter of self-protection, had to take steps in order to cover their liabilities under the above Act, the local authorities throughout London do not find the question of such urgency as to render speedy action in any way necessary, seeing that the long-suffering ratepayer is at hand to meet any liabilities which may arise. The London County Council, as Lord Welby pointed out last week, did not intend to do anything until it was seen how cases under the Act were decided; and even when action was taken it was proposed that the Council should insure its own workmen, and not that the risk should be undertaken by a company. In this connection it is to be noted that the Parliamentary and General Purposes Committee of the Islington Vestry has considered the question in accordance with a reference made three months ago, and the action of the Vestry may be of interest to many. The Committee express the opinion that the Vestry will be liable to pay compensation for accidents, &c., in accordance with the scale and conditions set out in the first schedule to the Act, to persons engaged in, or in connection with, its steam laundries, and to any workman in its own employ engaged in the construction, alteration, or repair of sewers, or in the construction, alteration, and repair of roads where machinery driven by steam or other mechanical power is used, and also to the employés at the electric lighting station, notwithstanding that, as the Vestry Clerk has pointed out, it does not conclusively appear, from the reading of the Act and the Acts incorporated therewith, that it affects the last-mentioned class of workmen; that in connection with the matter it has obtained the following quotations from some insurance companies of the rates of premium they would require to be paid to insure the Vestry in respect of its liability under the Act:—

Rates of Premium.

Accident Insurance Company.—Rate for insuring the Vestry in respect of its liability under the Workmen's Compensation Act, 1897, under the Employers' Liability Act, 1880, and at common law, 17s. 6d. per £100 wages paid per annum. (N.B.—Certain employés at the Vestry's electric lighting and disinfecting stations are at present insured with this office in respect of the Vestry's liabilities under the Employers' Liability Act and at common law.)

Employers' Liability Assurance Corporation.—Rate required to cover the *whole* of the Vestry's employés is 17s. 6d. per cent. of the wages paid per annum. The rate required to cover the employés at the electric lighting station only (including risk of shock) is 50s. per cent. These rates are subject to the special discounts set out in the company's letter of June 9th, when the wages paid exceed £10,000 per annum. The company are prepared to entertain a profit sharing scheme if the wage roll reaches £100,000 per annum.

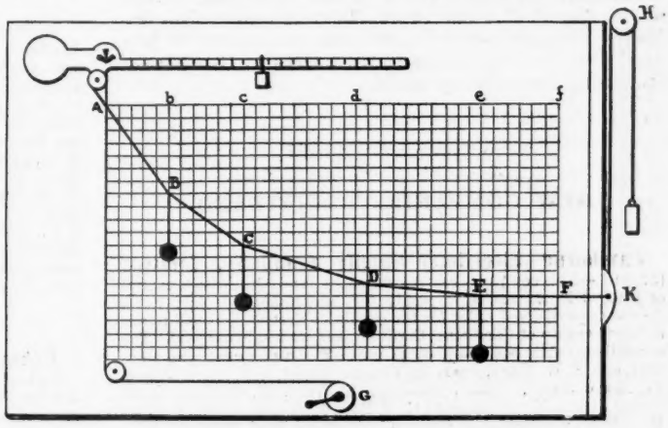
The Ocean Accident and Guarantee Corporation, Limited, and the *Sun Office*, are prepared to give quotations on a proposal being submitted to them on one of their proposal forms.

The Parliamentary Committee recommended, and it was decided, after a long discussion in full Vestry last Friday, that having regard to the high rates of premium required by the insurance companies, the Vestry's risks under the Act should not be insured until experience has been gained of the working of the Act. It may be mentioned that the Vestry of St. Margaret and St. John, Westminster, is convening a conference of local authorities to discuss the advisability of forming a united insurance fund from which claims under the Act could be met, and in the object of this conference the Vestry of Islington has concurred.

To the Board of Trade.—A correspondent writes:—"A point which I think wants bringing out is the very unfair distinction which is made between the local authority and a private company when applying for electric lighting powers. It is always acknowledged that a local authority has a preferential right to undertake electric lighting in its own district; but what I complain of is that when the local authority does not show any real intention of undertaking this duty, the Board of Trade do not encourage a private company. A local authority often obtains electric lighting powers with the avowed object of delay, having no intention of proceeding with it except under compulsion. There are a great number of such cases at the present moment in which the local authority has had powers for several years without any attempt to carry them out. I think the Board of Trade should insist that when a local authority has not exercised its powers within the time specified in the order—which is generally two years—that these powers should lapse."

Death of Dr. Herz.—The death of Dr. Cornelius Herz took place at the Tankerville Hotel, Bournemouth, on Wednesday morning. We are not concerned with the later phases of Herz's career; indeed, his connection with the Panama scandals, and his enforced sojourn in this country, are incidents that are still prominent in the minds of the public. It is, however, interesting to recall a period when Herz exercised an influence on electrical science; it was an influence for the most part baleful, but to mention that he was for a time in close association with Deprez and Count du Moncel is sufficient to show that he had some connection with honourable scientific efforts. It is not necessary to trace his early career in detail. He took up the study of medicine in early youth, and settled for some time in San Francisco as a medical electrician, subsequently drifting to Paris with a sheaf of electrical patents in his possession. The most interesting, and probably the most worthless, was one relating to a long distance telephone; yet eminent savants did not hesitate to declare that it solved the problem of long distance telephony. Between the years 1878 and 1880 Herz is said to have formulated the idea of establishing a syndicate to work the discoveries of savants in distress. Whether this beneficent project ever came to fruition it is impossible to say, but it is clearly established that Herz soon became associated with savants who were not in distress, and by the financial aid of two—Deprez and du Moncel—he established *La Lumière Electrique*. Although considerable prominence was given to electrical science, Herz's method of conducting the journal, to say the least, differed materially from the traditions so generally observed in this country. The most important electrical work with which Herz was connected was the experiments of transmitting electricity to a distance, instituted by Deprez, and though these costly experiments brought no reward to the originator, as the Electrical Review in 1882 pointed out, he took the lead in concentrating public attention on the subject of transmitting power to long distances; moreover, he demonstrated beyond all doubt the possibility of economically transmitting electrical energy. Herz, in later years, devoted himself exclusively to finance, with more or less success.

A Problem in Graphical Statics.—In the *Electrical World* (New York) of May 21st, Mr. William Hand Browne describes a pretty application of graphical statics to an electrical problem. Across a sheet of section paper on a drawing board in a vertical plane is hung a flexible cord A, B, C, D, E, F, carrying weights at B, C, D, E. A steelyard at A indicates the horizontal component of the tension T of the cord, which is, of course, constant all along the catenary, and can be adjusted by winding the cord up on the drum at G. The point, K, is adjustable on a vertical slide, and is supported by a cord and weight hanging over pulley at H. Then the line of the cord may be treated as a diagram of the fall of potential along a uniform conductor, feeding other circuits at various points. The uniform sectional area or conductivity is represented by T, the horizontal component of tension; the currents taken off at the feeding points B, C, D, E by the weights at those points, and the lengths of conductor between the several points by the horizontal distances A*b*, *bc*, *cd*, *de*, *ef*. Then the vertical distance of any point below the line A*f* represents the fall of potential between A and that point, and the current is given by the tangent of the inclination of the cord to the horizontal. It seems unlikely that the adjustment of all these weights and strings to the circumstances of a practical case could be easier than a numerical solution, but the device may serve as a suggestive illustration of the application of a graphical method to such problems.



Royal Institution.—A general monthly meeting of the members of the Royal Institution was held on 4th inst., Sir James Crichton-Browne, M.D., F.R.S., treasurer and vice-president, presiding. The special thanks of the members were returned for the following donations:—Sir F. Abel, £100; Sir D. Noble, £100; Sir J. Brunner, £50, to the fund for the promotion of Experimental Research at Low Temperatures.

Electrical Progress in Lombardy.—The following significant remarks are taken from Mr. Armstrong's consular report on trade in Lombardy:—"*Electrical Appliances.*—The use of electricity, both for lighting purposes and as a motive power, is constantly extending, and there is, consequently, an ever-increasing demand for all kinds of electrical appliances connected with this development. Some of these are now made in Italy, but by far the greater part come from Switzerland and Germany, two countries which appear to have made this industry—which has undoubtedly a splendid future before it—quite a speciality of its own, and they must find it a very profitable one. British engineering firms do not seem to be making any effort to secure a share of this business in Italy." It would be very gratifying if British firms could secure a share of the electrical work that is being done on the Continent; but it is doubtful whether we could effectively compete against foreign manufacturers on their own ground. Moreover, we question whether many of our electrical manufacturers possess the organisation necessary to extend business abroad.

The Brooklyn Elevated Railway.—By the time that these lines are in print, it is expected that the greater part of the work of equipping the Booklyn Elevated Railway for electric traction will have been completed, if, indeed, the electric cars be not actually running; and if, as may fairly be expected, the results give satisfaction, it is confidently thought that the New York lines will follow suit at a very early date. The conditions of traffic on the two systems of elevated lines in New York and Brooklyn respectively are somewhat different, inasmuch as the former has a tolerably steady traffic throughout the day, whilst at Brooklyn the rush of traffic comes in the morning and evening, requiring trains of at least 9 or 10 cars during about two hours at each period, as compared with, say, two-car trains during the day. It is not therefore to be wondered at that the Sprague "multiple unit" system should be adopted for the purpose of regulating the train capacity strictly in accordance with the requirements of traffic. From a description in the *Electrical Engineer* (New York), we understand that 75 cars are to be equipped at first, each with two Walker motors; the latter have each a rated capacity of 80 H.P., running at 450 revolutions per minute. With 33-inch truck wheels, a speed reduction of 2·78 to 1 is employed, the gears having pitch line diameters respectively of 20 and 7·2 inches, with teeth of 5-inch face and 2½-inch pitch. The motors are completely enclosed in the usual way by the steel magnet frames, which are circular in shape. The bearings are in hard bronze, 10 inches long, 4 inches diameter, and the axles 5¼ inches diameter. The windings, both on fields and armatures, are of bar copper, insulated with mica and asbestos; the armature windings are sunk into deep slots and covered with asbestos, and the projecting armature core teeth provide an air space of nearly $\frac{3}{8}$th inch beyond the armature windings, with their insulation and binding wires, &c. The cars are to maintain a speed, including stoppages, of not less than 16 miles an hour, though this speed can be increased, if necessary, by grouping together all the four motors on any one car. There seems no need to anticipate the least difficulty in the motor construction or circuit arrangements, in view of

what we all know has been done so effectively at Liverpool; but what will be especially and particularly interesting is the proposed adoption of the Sprague system of grouping of various motors on the train, so that they may, without trouble, be worked altogether from any one point or platform. Practical railway men will appreciate the great ease and economy of running trains only large enough for the probable traffic, and increasing the capacity on short notice without overloading the driving mechanism. In fact, the system offers all the advantages of a steam locomotive provided not merely with automatic cut-off or expansion gear, but also with elastic boiler and cylinders, if such a device could be imagined, so that the output would vary in strict accordance with the demands upon the engine. Indeed, it is superior to any such a steam device, since the weight of driving mechanism in the train varies exactly with the train capacity, each new car having its own motors, which fall into unison for working with the others in the train as soon as the new car is coupled up. If Mr. Sprague has really provided the electric railroad industry with a sound practical device in his multiple unit controller, he will have made his name famous for that alone, irrespective of any previous good work that he has done.

King's College Conversazione.—The annual conversazione and distribution of prizes took place on Wednesday evening, a varied programme affording entertainment to a very large company. The distribution of prizes was conducted by the Rt. Hon. J. W. Lowther, M.P., after which the guests were received by Dr. Robertson, Mrs. Robertson, and the staff. Interesting exhibitions and demonstrations were arranged in the various rooms, and the laboratories, museums, and studios were open for inspection. In addition a concert by students of the ladies' department was given in the Great Hall, and a band played at intervals at first in the Entrance Hall and afterwards on the terrace, where also some experiments were shown in wireless telegraphy.

Personal.—Mr. Wilfred King, who has for many years past filled the office of secretary of the company and assisted in the management, has been appointed managing director of the Exchange Telegraph Company, in the place of the late Captain W. H. Davies.

Calcium Carbide.—The Deutsche Gold and Silberscheide Anstalt of Frankfort-am-Main, in conjunction with Messrs. Brown, Boveri & Co., of Baden, are reported to have decided on the construction of large works in Germany for the production of calcium carbide.

NEW COMPANIES REGISTERED.

Camborne Electricity Supply Company, Limited (57,950).—This company was registered on June 27th, with a capital of £10,000 in £1 shares, to apply for, undertake, and carry out a license or provisional order for the supply of electric light and power in the township of Camborne, Cornwall, and its neighbourhood. The subscribers (with one share each) are:—F. Crawter, electrical engineer, and E. E. Sharp, clerk, 39, Victoria Street, S.W.; A. C. Moore, 23, Essex Street, Strand, solicitor; A. Ward, 30, Marquis Road, Stroud Green, N., accountant; G. E. Barr, 9, Millman Street, Bedford Row, W.C., gentleman; A. Green, 67, Athenlay Road, Nunhead, S.E., accountant; F. T. Dorman, 23, Essex Street, Strand, W.C., solicitor. The number of directors is not to less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company.

Whitstable Electric Light and Power Company, Limited (57,952).—This company was registered on June 27th, with a capital of £5,000 in £5 shares, to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—J. L. Higgs, solicitor, W. F. Fearn, solicitor, and J. Howe, clerk, 3, Delahay Street, Westminster; A. G. New, The Voltage, Woking, engineer; E. Mann, 10, Palace Chambers, Westminster, engineer; W. H. Trentham, 39, Victoria Street, S.W., engineer. The number of the directors is not to be less than two nor more than seven; the subscribers are to appoint the first; remuneration, one-tenth of the net profits, divisible.

Potteries Electric Traction Company, Limited (57,968).—This company was registered on June 28th, with a capital of £400,000 in £10 shares (20,000 preference), to carry on the business of carriers of passengers and goods, electrical engineers, electricians, engineers, contractors, manufacturers of and dealers in railway, tramway, electric and other apparatus, and suppliers of electricity. The subscribers (with one share each) are:—J. V. Kitchener, superintendent, E. Garcke, electrical contractor, S. P. W. A. Sellon, civil engineer, and G. Stevens, secretary, all of Donington House, Norfolk Street, W.C.; C. Walmsley, 17, Priory Road, Kew, accountant; C. H. Gadsby, 21, Fordwych Road, West Hampstead, engineer; T. B. Goodyer, 14, Woburn Place, W.C., traffic superintendent. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £500 per annum and a percentage of the profits, divisible. Registered office, Donington House, Norfolk Street, Strand, W.C.

River Po Electric and Power Syndicate, Limited (57,983).—This company was registered on June 29th, with a capital of £10,000 in £1 shares (1,000 deferred), to adopt an agreement with Luigi de Beffa for the acquisition of certain property, and to carry on the business of electricians, mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—C. E. Bradley, 29-30, King Street, Cheapside, chartered accountant; E. H. Ludlow, Langley, near Birmingham, brewer; W. H. Sidley, 12, Augusta Street, Birmingham, gentleman; W. H. Parker, 79, Fordwych Road, West Hampstead, secretary; E. J. Broadbent, 25, Albion Square, Dalston, clerk; F. Davies, 121, Fordwych Road, Kilburn, chartered accountant; E. Pope, Cambrian Lodge, New Barnet, merchant. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £100 each per annum. Registered office, 65, New Broad Street, E.C.

Twickenham and Teddington Electric Supply Company, Limited (57,984).—This company was registered on June 29th, with a capital of £25,000 in £5 shares, to carry on the business of electrical engineers, electricians, practical engineers and contractors, electrical apparatus manufacturers, and suppliers of electricity. The subscribers (with one share each) are:—F. E. Gripper, Clifton Villa, St. Margaret's, S.W., electrical engineer; H. J. Read, Greenfield Villa, Liverpool Road, St. Albans, engineer; F. Payton, Fairlight, Taybridge Road, Clapham, S.W., clerk; H. I. Butcher, Lancaster Road, New Barnet, gentleman; J. C. Wigham, Albany House, Monkstown, co. Dublin, engineer; E. H. Blow, 16, Etta Street, Deptford, S.E., electrician; S. K. Thompson, 28, Millbank Street, S.W., electrician. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first; qualification, 20 shares; remuneration as fixed by the company.

Lymington Electric Light and Power Company, Limited (57,985).—This company was registered on June 29th, with a capital of £10,000 in £5 shares, to carry on the business of electrical and mechanical engineers and contractors, electricians, electrical apparatus manufacturers, and suppliers of electricity. The subscribers (with one share each) are:—F. E. Gripper, Clifton Villa, St. Margaret's, S.W., electrical engineer; H. J. Reed, Greenfield Villa, Liverpool Road, St. Albans, engineer; F. Payton, Fairlight, Taybridge Road, Clapham, S.W., clerk; H. I. Butcher, Lancaster Road, New Barnet, gentleman; J. C. Wigham, Albany House, Monkstown, co. Dublin, engineer; E. H. Blow, 16, Etta Street, Deptford, S.E., electrical engineer; S. K. Thompson, 28, Millbank Street, S.W., electrician. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 20 shares; remuneration as fixed by the company.

Urban Electric Supply Company, Limited (57,986).—This company was registered on June 29th, with a capital of £100,000 in £5 shares, to carry on the business of electrical engineers, electricians, practical engineers and contractors, electrical apparatus manufacturers, and suppliers of electricity. The subscribers (with one share each) are:—F. E. Gripper, Clifton Villa, St. Margaret's, S.W., electrical engineer; H. J. Read, Greenfield Villa, Liverpool Road, St. Albans, engineer; F. Payton, Fairlight, Taybridge Road, Clapham, S.W., clerk; H. I. Butcher, Lancaster Road, New Barnet, gentleman: J. C. Wigham, Albany House, Monkstown, co. Dublin, engineer; E. H. Blow, 16, Etta Street, Deptford, S.E., electrician; S. K. Thompson, 28, Millbank Street, S.W., electrician. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 20 shares; remuneration as fixed by the company.

Sandgate and Hythe Electric Company, Limited (57,997).—This company was registered on June 29th, with a capital of £1,000 in £10 shares, to carry on the business of electricians, electrical engineers, contractors, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each)

are:—E. Garcke, electrical contractor, and C. H. Dade, assistant, Donington House, Norfolk Street, W.C.; G. Stevens, Maycroft, Queen Anne Avenue, Bromley, Kent, secretary; C. H. Gadsby, 21, Fordwych Road, West Hampstead, engineer; C. Walmsley, 17, Priory Road, Kew, S.W., accountant; T. B. Goodyer, 14, Woburn Place, W.C., traffic superintendent; H. S. Hodgson, Platt's Eyot, Hampton, secretary. The number of directors is not to be less than three nor more five; the subscribers are to appoint the first; qualification, £250; remuneration as fixed by the company.

British Free Electric Light Wiring Syndicate, Limited (58,013).—This company was registered on June 30th, with a capital of £10,000 in £1 shares, to adopt an agreement with W. C. Johnson, trading as "Johnson and Phillips," and to construct, lay down, establish, fix, and carry out any cables, wires, batteries, lamps, motors, dynamos, plant, &c. The subscribers (with one share each) are:—W. C. Johnson and C. H. Johnson, The Dignaries, Westcombe Park, Blackheath, gentlemen; S. Paterson, electrical engineer, and P. M. Randall, Granville Chambers, Orchard Street, W.; J. Macgregor, 26, Park Place, Greenwich, accountant; L. Hunter, 33, Alfred Place West, South Kensington, surveyor; G. Whale, Woolwich, Kent, solicitor. The number of directors is not to be less than two, nor more than six; the first are W. C. Johnson and S. Paterson; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

London Electric Supply Corporation, Limited (24,957).—This company's annual return was filed on June 10th. The capital is £1,250,000 in £5 shares (50,000 preference). 111,000 ordinary and 48,050 preference have been taken up, and £5 per share called. £798,990 has been paid, including £3,740 received on 1,950 forfeited shares.

Llandrindod Wells Electric Light and Power Company, Limited (48,340).—This company's annual return was filed on June 3rd; 990 shares have been taken up out of a capital of £5,000 in £5 shares, and £4,950 has been paid.

CITY NOTES.

Thomas Parker, Limited, Wolverhampton.

The annual meeting of the shareholders was held at the works on Tuesday last. The meeting was presided over by the chairman of the company, Alderman C. T. Mander, J.P.

The Chairman moved the adoption of the report, which appeared in our issue of last week. He said that the company had gone along swimmingly during the last year. They might, perhaps, have done more business, but they had been hampered by the engineers' strike of last year, and machinery that they had on order a couple of years ago, in some cases was hardly in position at the present time. The result was, that what machinery they had had in—new machinery since the last meeting—had hardly been able to show its capacity as yet. He rather regretted one thing in the report, and that was, that in the statement that they wanted to create more debentures, it was not made fully clear that those debentures were partly to take up debentures that were already issued, or not exactly issued, but, as he termed it, sort of put in pawn. They never issued debentures as such at the time, but if they issued £50,000 worth of debentures now it would leave them a good balance in hand, which would naturally all go into the business, either in the shape of more machinery, which was badly needed in some parts, or, on the other hand, as book debts, so that nobody need have any fear of taking up the debentures, because they really had ample assets to show for them, and the more debentures taken up the more assets there would be. It gave him very great pleasure to be able to congratulate the shareholders on the result of the year's trading.

Mr. Thomas Parker seconded the adoption of the report. In doing so he said he felt they had arrived at a stage in the history of the company when there was cause for considerable gratification. They had contracts next year for a million sterling, so much had the people fallen in love with their work. Therefore, if the shareholders supported them, as they had every confidence they would, there was a prospect of having a property there that would be entirely satisfactory to them all. Their volume of business was so raised that they had outstanding debts owing to the company to the amount of £38,853, as against £19,866 owing to them last year. That was a very considerable sum locked up over and above what they had so locked up a year ago. That increase, he added, corresponded with a comparison of the amount of work proceeding in the shops, and it meant that they had become short of capital to that extent.

Mr. Smith Heaton desired to know what depreciation they allowed on goodwill? In other words, in how many years did they intend to wipe out the goodwill? He also inquired what they allowed for depreciation of machinery, and remarked that it was old machinery—it was only worth scrap iron

Mr. Gordon remarked that they might have a difficulty in raising the £50,000 debentures, and if they did not get all the shares taken up it would be rather a reflection upon the company. He suggested that it might have been wise to have issued some more share capital, and not have it all taken up.

Mr. Loftus Moreton directed attention to the large increase in the amount owing from debtors, and asked whether that was the natural increase of the business?

The Chairman, in explanation, said they might have difficulty with the income-tax authorities if they struck 5 per cent. off their machinery for depreciation. Their machinery was always kept up with renewals, too, and practically was in as good a condition as when it was put in. They had knocked 10 per cent. off tools, and a large amount off patterns, &c. As regards the goodwill and patents, their patents were probably worth double what they were put down in the books, and they had also made additions by introducing new patents which were of considerable value, but which were not charged in the books. There would be a better dividend for the present shareholders under the directors' plan than if they had issued fresh capital paying 8 per cent. He remarked that their shares were now quoted on the Birmingham Stock Exchange at 15½, and expressed himself sanguine that the debentures would go. Already, amongst the present shareholders, £9,000 had been allotted. In reply to Mr. Moreton, he stated that the increased amount owing was only the outcome of increased business. That was why they wanted more capital to go on with, because for every tool they spent £1,000 on, it meant £1,000 in book debts at the same time. They must take the word of their directors that they personally were very well satisfied with the way the business was going on, and that the additional capital was necessary to increase their trade. They could have paid more in dividend, but he thought they had done wisely in carrying £2,000 to the reserve fund. They paid 5 per cent. the first year, and 7 per cent. last year, and now they had got to 8 per cent., and he thought if they kept a steady 8 per cent. or thereabouts, they would be in as good a financial position as they could wish.

The report was adopted.

On the motion of the Chairman, seconded by Mr. R. Armistead, a dividend of 8 per cent. was ordered to be paid.

India-Rubber Company.

The half-yearly ordinary meeting of the India-Rubber Company was held at the Cannon Street Hotel yesterday, when the chairman, Hon. Henry Marsham, presided.

The Secretary read the notice convening the meeting.

The Chairman said that as the shareholders were aware, no report or balance-sheet was laid before them at that meeting, they having only been called together to pass the resolution declaring the half-yearly dividend of 2½ per cent., or 5s. per share. Up to June 30th an advance had been made upon the corresponding period of last year. As the shareholders knew, the price of rubber and gutta-percha had risen, and the company had had to unwillingly raise their price. There had been a still further rise in gutta-percha within the last 10 days, consequently the company had to increase their price still higher. In the matter of submarine cable work the company had had little to do. Their steamer had been doing work at sea, and had raised a cable in 2,600 fathoms, repaired and spliced the same. The company had every confidence in their staff. He had much pleasure in moving that a 2½ per cent. dividend, or 5s. per share, free from income-tax, be declared.

On the motion being put it was carried unanimously, and the meeting then terminated.

United River Plate Telephone Company.

The twelfth ordinary general meeting of the shareholders of this company was held on Tuesday at Winchester House, Old Broad Street, Mr. J. Irving Courtenay in the chair.

The Chairman, in moving the adoption of the report, said it needed no words of his to show that the position of the company was a very satisfactory one, and that, from the evidence before them of the gradual and sure progress of the company, there was every reasonable anticipation of a safe and prosperous future. It would be remembered that after weathering the financial crisis, 1890 to 1893, during which many River Plate enterprises not only failed to pay dividends, but defaulted on their debenture interest, their company, which had never failed to promptly meet every item of its indebtedness, began to be again dividend paying. It was a modest 3 per cent. dividend for the year 1894, but it was 4 per cent. for 1895, 5 per cent. for 1896, and now it was to be 6 per cent. for 1897. For each of those years a substantial sum was also carried forward. For the last, the one they had especially before them that day, they not only did all and more than they had done in any previous year, but they proposed also to place the handsome sum of £10,000 to a reserve fund. He thought they might, with reason, congratulate themselves on their position. The item of profit and loss in the balance-sheet was a particularly satisfactory one. The balance from the previous year, £7,576, was the largest they had ever brought forward; the profit for the year, £23,539, was larger by £3,000 than for any previous year, and the amount refunded on account of taxes, £6,240, provided a substantial sum towards a reserve fund. The total of £37,355 left a practical reserve, after paying 6 per cent. dividend, of £20,000. The additional outlay in capital expenditure had amounted to £4,121, or £526

less than for the year before. That item had been for many years kept down to the closest possible figure, by charging to revenue much that might have been put to capital account. They had had constantly before them the expenditure which would become necessary consequent upon their large increase in subscribers and the improved plant which it would be imperative to arrange for by the time they were in occupation of their new central office in Buenos Ayres. In the meantime, every economy in expenditure consonant with giving good service had been practised, with the result that they were now in a position to go ahead to the best advantage with the necessary outlay. With reference to the profit and loss account, the first item, subscriptions, rentals, messages, sales, &c., in the River Plate, £67,208, showed the satisfactory increase of £6,883 over the previous year. While this large increase was in part owing to the more favourable gold premium, which averaged during the year 182 per cent., as against 192 per cent, it was mainly due to the increased collections from new business. They might be too sanguine in looking for a further equal increase during the present year, but it might be said that, up to the present, the collections for this year showed every indication of considerably exceeding those of last year. The charges for maintenance, salaries, wages, &c., in the River Plate, were £33,780, or £3,576 more than last year. That increase, although largely attributable to the increased force required, was also due, to a considerable extent, to the reduced gold premium, which, of course, gave a larger sterling value to all salaries and wages payable in paper. Expenses in London, £2,977, were £362 more than for the previous year, owing to the directors now taking the fees due to them under the articles of association. This was the first time in eight years that the directors had taken the fees to which they were entitled. While the company suffered under the great depression in Argentina, and paid no dividends, the directors voluntarily waived the one-half of their fees. As the company resumed paying dividends, they, by degrees, had resumed their compensation. It was trusted that that action met their approbation. The proposed appropriation of profit was perhaps not the least pleasing of the figures they had presented. With a total, after paying their debenture interest, of £37,355 at their disposition, they proposed to pay a 6 per cent. dividend, to put £10,000 to a reserve fund, and £3,000 to depreciation fund, carrying forward £6,955.

Mr. F. W. Jones seconded the adoption of the report, which was carried unanimously.

The Chairman announced that the directors had decided to issue the remainder of their debenture stock, amounting to £48,267. It was intended to confine the issue to the present shareholders, and the stock would be offered at a small premium.

A vote of thanks to the chairman concluded the proceedings.

The Great Northern Telegraph Company, Limited, of Copenhagen.

The following is an abridged report of the extraordinary general meeting of this company held at Copenhagen, May 23rd, 1898.

The chairman and managing director of the company, Commodore E. Suenson, asked the meeting whether it was desired that he should repeat the reasons for every single point of the proposed modifications, as given at the last ordinary general meeting. No one desiring this, he confined his remarks to a repetition of the principles and the general reasons which had induced the board of directors to propose the alterations:—The very antiquated form of the present articles in some places. The fact that many of the company's shares are now in French hands, make it desirable that the articles of association should be altered, so as to place the French shareholders on the same footing as the Danish and English. The experience gained during a number of years with regard to the scope and conditions for the operations of the company has shown the necessity of legalising the actual state of affairs, so as to give the board of directors free hands to continue the development of the company on the basis of paragraph 3 of the articles of association, as altered, as long as the amount of capital authorised by paragraph 4 is not exceeded.

A Shareholder proposed as an amendment a slightly different wording of paragraphs 5 and 21, which was accepted by the board of directors without discussion. As no one else desired to be heard, the motions were put to the meeting, the above-mentioned amendment being first submitted and carried unanimously. The entire proposal of the Board as amended was then put and also carried unanimously, the voting in this case being by ballot.

Monte Video Telephone Company.

An extraordinary general meeting of the shareholders of this company was held on Wednesday at Winchester House, Old Broad Street, Mr. Herbert Ward presiding.

The Chairman said that the object of the meeting was to pass a resolution to reduce and sub-divide the capital of the company, so that it might more accurately represent the company's assets. The directors were animated with but one object, and that was to improve the position of the company. He was reminded by the date of the meeting that they were within three weeks of the tenth anniversary of the incorporation of the company, and their prospects, which seemed so prosperous in 1888, became suddenly shattered by the collapse in Uruguay two years later, a collapse by which all commercial enterprise in the country was completely paralysed. They had survived those years of panic and trouble, and improved the efficiency of the service, struggling all the time to carry out their expectancy as to a return on the capital. They had been able to pay 4 per cent. on the 6 per cent. preference shares for the last four years, and had kept their plant up in an efficient manner, which showed that they had a sound business to deal with, and the time had now arrived when it was desirable to so re-arrange the capital, that its present earnings might be fairly distributed. The suggestion for the re-arrangement first emanated from a very large preference shareholder, and one who happened to hold no ordinary shares whatever. So long as a share did not earn its full dividend it suffered a market depreciation, and therefore a 5 per cent. preference share on which the full dividend was paid would be of more value than a 6 per cent. share on which only 4 per cent. was paid. The directors had therefore proposed the following re-arrangement of the capital, which was equitable to all parties:—(1) To give to the present preferred shareholders, for every share which they now hold, three £1 cumulative 5 per cent. preference shares, non-preferential as to capital, and two £1 ordinary shares; (2) To give to the present ordinary shareholders, for every share they now hold, one £1 ordinary share; (3) To give to the holders of the promissory notes issued in lieu of dividend in 1892, three preference shares of £1 each, and two ordinary shares of £1 each for every £5 so held. If the arrangement was carried through there was every prospect of the full dividend being paid on the preference, and also of a dividend being paid on the ordinary shares. He concluded by proposing a resolution for carrying the arrangement into effect.

Mr. W. Jones seconded the proposal, which, after some discussion, was carried unanimously.

Brompton and Piccadilly Circus Railway Company.—The prospectus of this company has been issued, offering the whole of the share capital in £10 shares. The line will run from South Kensington station, under the Brompton Road to Piccadilly Circus, with five intervening stations. It is to be completed within 2½ years from commencement, and will consist of two iron-cased tunnels, each of 11½ feet diameter. Electricity will be generated at a station on the river Thames at Chelsea. Interest out of capital, at the rate of 3 per cent. per annum, not exceeding £30,000 in the whole, is to be paid during construction.

City and South London Railway Company.—The accounts for the half-year ended June 30th show a balance, after providing for the debenture interest and the dividend on the preference shares, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 2¼ per cent. per annum, carrying forward a balance of £1,005. The dividend for the corresponding period last year was at the rate of 2 per cent. per annum, the balance carried forward being £1,035.

British Electric Traction Company.—First issue of £100,000 5 per cent. perpetual debenture stock at the price of 116 per cent. is announced. It is provided by the trust deed that in the event of the voluntary liquidation of the company the debenture stock shall not be repayable at a less price than £130 for every £100 stock. Considering the present position of the company, the stock will no doubt be readily taken up.

The St. James's and Pall Mall Electric Light Company, Limited.—This company notifies the declaration of an interim dividend on the preference shares at the rate of 7 per cent. per annum, and on the ordinary shares at the rate of 10 per cent. per annum for the half-year ending June 30th.

Electric Construction Company, Limited.—The directors recommend a dividend on the ordinary shares for the year ended May 31st at the rate of 6 per cent. per annum, one-half payable on July 30th, 1898, and the other on January 31st, 1899.

Notting Hill Electric Lighting Company.—An interim dividend for the half-year ended June 30th, at the rate of 6 per cent. per annum on both the ordinary shares and ordinary preference shares, has been declared.

W. T. Glover & Co., Limited.—Notice is given, that the transfer books and register of members of the above company will be closed from Thursday, July 7th, to Friday, July 15th, both days inclusive.

Electrical Power Storage Company, Limited.—The net profits for the half year ending May 31st, were £4,389. A dividend of 5 per cent. is recommended.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 1st, 1898, were £2,884 11s. 1d.; corresponding period 1897, £2,461 3s. 9d.; increase, £423 7s. 4d.

The City and South London Railway Company.—The receipts for the week ending July 3rd, 1898, were £988; week ending July 4th, 1897, £1,031; decrease, £43; total receipts for half-year, 1898, £988; corresponding period, 1897, £1,031; decrease, £43. Miles open 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 1st, 1898, were £182 19s. 4d.; total receipts to July 1st, 1898, £3,208 15s. 0d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for six days ending June 30th, 1898, were £663 18s. 8d.; corresponding week last year, £724 2s. 3d.; decrease, £60 3s. 7d.; passengers carried, 99,134; corresponding week last year, 102,975; aggregate to date, £13,114 7s. 1d.; aggregate to date last year, £13,924 3s. 2d.; decrease to date, £809 16s. 1d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 3rd, 1898, amounted to £1,566; corresponding week last year, £1,416; increase, £150.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending July 1st, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £2,594.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, June 29th.	Closing Quotation, July 6th.	Business done during week ended July 6th, 1898. Highest.	Lowest.
137,400£	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	99 —103xd	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	93 — 96	92 — 95xd	...	...
923,960£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	65 — 68	67	65
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	116½—117½	116½—117½	117⅜	116½
3,038,020£	Do. do. Deferred...	Stock	...	...	...	16½— 17	16½— 17¼	17⅛	16⅝
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16xd	15½— 16	16	15⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	112 —116	111 —115 xd	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190xd	180 —190	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106xd	104 —106	105¼	104¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	14½— 15½	14½	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	103 —106%	102—105%xd	...	...
60,710£	Direct United States Cable	20	2¼ %	2¼ %	...	10¼— 11	10¾— 11¼	11	10¾
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	100—103 xd	101¼	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	...	17¼— 17¾	17¼— 17¾	17 1/16	17 5/16
70,000	Do. 6 % Cum. Pref.	10	6	6 %	...	... ...	... ...	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	123 —127	123 —127	125	123¼
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 18	17½— 18	17⅝	17½
25,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	98 —102 xd	...	...
100,500£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	99 —102 xd	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	123 —127	124 —128	127	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	98 —103 xd	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	99 —102 xd	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	11½— 12	11½— 12	11⅞	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½— 17	16½— 17	17	16⅞
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	29½— 30½	29 — 30	...	...
160,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,000	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	100 —105	99 —103 xd	100½	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	52⅝	51⅜
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5⅜— 5⅝	5⅜— 5⅝	5½	5⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	15⅝	15⅜
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 1/16	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100—105xd	100—105 xd	103	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	¾	11/16
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	104 —107 xd	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	...	4 — 4¼	4¼— 4⅜	4⅝	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106xd	103 —106 xd	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400£	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ¾	¼— ¾	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	105 —108 xd	103 —106 xd	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	11½— 12	11½— 11⅝	11⅝	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7¼— 7⅜	7¼— 7⅜	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½ %	4½— 5	4½— 4⅝	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106xd	103 —106 xd	104½	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	¾ %	½— ¾	½— ¾	11/16	⅝
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	7½— 8	7⅝— 8⅛	8	7⅞
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	104 —107 xd	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100£	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11 — 12	11 — 12	11⅝	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ...	5	5 %	5 %	6 %	8 — 9xd	8 — 9 xd	8¾	8⅜
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	113 —115xd	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	26 — 27	25½— 26½	26⅜	26
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ...	10	...	...	...	18 — 19	25 — 26	25¾	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15½— 16½	16⅜	16⅛
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	125 —130xd	125 — 130xd	126¼	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	12½— 13½	12½— 13½	13	12 1/16
10,000	Do. do. do. Nos. 30,001 to 40,000 £6 paid.	10	...	...	...	6 — 7	8 — 9	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14½— 15½	14⅞	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £6 paid	5	...	...	...	3½— 4½	3½— 4½	3⅞	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	8 — 9	8 — 9	8⅜	...
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	14½— 15½	14½— 15½	15⅜	15⅛
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	116 —120xd	116 —120	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	14 — 15	14½— 15½	14 15/16	14⅞
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	15½— 16½	15½— 16½	16⅛	15⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅜	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108xd	105 —108 xd	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2 — 2½	1¾— 2¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	14½— 15½	15 — 16	15¾	15½

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation June 29th.	Closing Quotation July 6th.	Business done during week ended July 6th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	17 — 17½	17 — 17½	17 11/16	17
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £7 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	10½— 11	10½— 11	10 9/16	10½
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½ %	*nil*	*nil*	1⅜— 2	1⅜— 2	1⅞	1 13/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2 — 2¼	2 — 2¼	...	...
125,000l	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	99 —102 xd	99 —102	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10⅛xd	9⅜— 10⅛	10 5/16	10
129,179	Do. do. do. £6 paid ...	10	...	...	...	5⅜— 6⅛xd	5⅜— 6⅛	6 3/16	...
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1½— 1¾xd	1½— 1¾	...	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4¾xd	4¼— 4¾	...	...
630,000l	City and South London Railway	Stock	1 3/16 %	1 3/16 %	1⅞ %	68 — 71	68 — 71	70	69¼
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	1⅜— 2¼	2⅜— 3¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1¾— 2¼	1¾— 2¼	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	89 — 94	88 — 93	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅛ %	...	2¼— 2⅜	2¼— 2⅜	2⅜	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅛ %	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103 xd	101 —103xd	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	...	2¼— 2⅜	2⅜— 2⅞	...	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛— 3⅜	3⅛— 3⅜	3 1/16	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	⅜— ⅝	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600l	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½ %	7 %	7 %	8 — 10 xd	8 — 10xd	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	21½— 22½	21½— 22½	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	4½ %	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	22	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	2⅞ %	3½ %	10 5/16— 10 7/16	10⅜— 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾— 16¼	15¾— 16¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 38	36 — 39	38	37
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	100 —103xd	100½	...
540,000l	Waterloo and City Railway, Ord. Stock	100	...	...	...	122 —127	122 —127	125¾	124

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10¼.

House-to-House, 4½% Debentures of £100, 105—108.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—12¼; 1st Preference Cumulative 6%, £5 (fully paid), 7⅜—8¼. Debentures, 106—109. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3¼—4.

*T. Parker, £10 (fully paid), 15.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8¼—8⅜. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 2½ per cent. (June 30th, 1898).

THE SIEMENS-HALSKE SLIDING CONTACT FOR ELECTRIC TRAMWAYS.

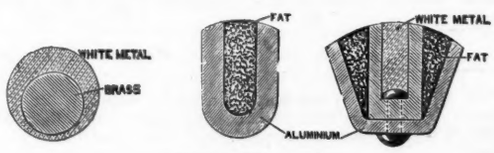
In electric tramways with an overhead conductor, the current is taken off from the conductor, as a rule, either with a roller or a sliding contact. While the roller or trolley wheel is used exclusively in America (the country where it originated), and also in most cases in Germany, the arched sliding contact has hitherto been employed on the lines constructed by Messrs. Siemens & Halske.

FIG. 1.

The first extended applications of the sliding contact were made at Hanover and at Dresden. At the latter place there are 165 motor tramcars at work fitted with the sliding contact, and Herr Stobrawa,* inspector of the city power station, has given a valuable report on the working of this device as compared with the trolley, derived from the extensive experience at Dresden.

When the arched sliding contact was first used at Dresden in 1893, the contact bar was of iron, and rapidly wore away the trolley wire, not only on account of the hardness of the material of the contact bar, but because the frame was heavy and a strong pressure had to be applied to overcome its inertia and obtain good contact. This defect in the working of the iron contact was observed before much harm was done, and the iron contact bar was replaced by a brass rod with a coating of soft metal (figs. 1 and 2). By this device the wearing away of the trolley wire was stopped, all the wear taking place on the contact bar, which could be easily renewed. A further improvement was made by the introduction of a device for lubricating the trolley wire, which had the effect of still further reducing the wear and friction, and also of stopping the disagreeable noise caused by the rubbing of the dry contact on the trolley wire. The new contact bar was made of aluminium, with channels to contain the lubricant; two of the most commonly used sections being shown full size in figs. 3 and 4. Aluminium was chosen for the contact bar with a view of reducing its inertia, and thereby reducing the pressure necessary to make good contact.

Since 1894 the frames of the sliding contacts used at Dresden have been made with depressible axes, fig. 5, a construction which reduces the strain on the arch during reversal and gives a flexible and



FIGS. 2, 3, AND 4.

delicate support to the whole frame. This arrangement has been found to be in every respect satisfactory. The triangular form, fig. 6, of the new frame has been found to be a great improvement on the old square frame, which was liable to hook on to the trolley wire. In case the arch should slip from under the trolley wire, which may happen when the trolley wire is considerably off the centre of the track, the friction between the trolley wire and the sides of the moving frame is sufficient to bring the arch again under the wire, a movement which is assisted by the elasticity of the side bars of the frame (see fig. 6). It is, therefore, impossible for the contact frame to strike the cross wires and bring down the trolley wire. One specially important advantage of the Siemens-Halske sliding collector is, that the contact at the trolley wire cannot be accidently broken in ascending steep gradients.

Owing to the small diameter of the tubes of which the frame is made, it becomes almost invisible at distances over 100 paces.

The fact that the sliding contact reverses itself automatically results in a great saving of labour to the tramway officials. This is

* *Elektro. Zeitsch.*, 1898, p. 103.

more especially the case at terminal stations; and when traffic is disturbed by the blocking of the streets and the officials are fully occupied looking after points, &c. The trolley, on the contrary, when the car is reversed, must be taken off the trolley wire, turned round the car and again placed on the wire, an operation which can only be carried out while the car is standing still.

Contact bars with the sections shown in figs. 2 and 3 are still in use at Dresden on the same lines, and they both show themselves to be

Fig. 5.

equally good. At other places, excellent results have been obtained with the aluminium contact rail alone. The life of a bar coated with white metal is about two weeks; after which the coating must be renewed. The life of an aluminium contact rail is six to eight weeks (about 4,800 car miles). In Bâle, the life of an aluminium contact rail is said to be about 12,000 car miles, but this difference may be explained by the larger section of the aluminium contact bar used at Bâle. The maintenance of both kinds of contact bars costs about the same amount, namely, ·0084d., which is a negligible fraction of the total cost of maintenance.

As already mentioned, the greasing of the trolley wire reduces the wear and the noise caused by the rubbing. The layer of grease also makes it an easy matter to rub off the hoar frost and ice which forms on the wire in winter. Otherwise this coating of hoar frost and ice very rapidly destroys the contact bar. The layer of grease must be very thin, and should rather occasionally be renewed and uniformly distributed on the underside of the wire by hand, or by an appliance fixed on a pole, than by putting an excessive amount of grease on the contact bar.

Care must be taken, as already mentioned, to press the contact rail on the trolley wire with sufficient force to prevent springing off and

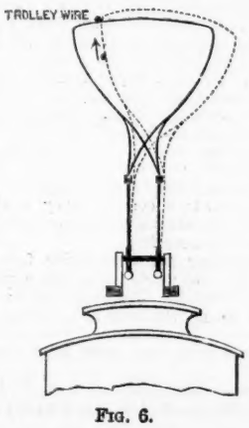


Fig. 6.

sparking. The Town Council at Dresden has fixed 7·7 lbs. as the upper limit for this pressure; but, as a matter of fact, the pressure is considerably less. The pressure of the trolley wheel is very seldom less than the above, since the risk of the wheel slipping off the rail has to be provided against.

The use of the Siemens-Halske sliding contact permits greater deviations of the trolley wire from the centre of the track than when the trolley wheel is used. For this reason, and by the consequent abolition of points and crossing pieces, the look of the trolley wire is much improved, and its construction cheapened. When the new lines were being constructed at Dresden, it was possible to work with temporarily fixed up trolley wires at difficult crossing points. The suspenders used by Siemens & Halske comprise a supplementary wire, which does not interfere with the look of the trolley wire, and serves to prevent the sliding contact striking against the cross wires.

It is frequently stated that the sliding contact wears away the trolley wire quicker than the trolley wheel. The experiments made at Dresden have convinced Herr Stobrawa that the sliding contact exercises the most beneficial influence on the durability of the trolley wire. The sliding contact, on account of its lightness, exercises only a very small pressure on the trolley wire, and the pressure is applied only on the underside of the trolley wire. The trolley wheel, on the contrary, rubs on the sides as well as on the underside of the trolley wire, more especially at curves where there is a lateral pressure from the flanges. Consequently, the trolley wire is worn away by the trolley wheel as shown at fig. 8, and by the sliding contact as shown at fig. 7. The worn surface, fig. 7, makes its appearance soon after the tramline is opened, but the wear makes very little further progress after about 3 mm. has been worn off a hard copper wire with a total diameter of 8 mm. The progress of the wear and tear of the wire has been carefully recorded at Dresden, by taking frequent measurements

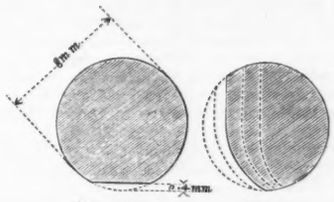


Fig. 7. Fig. 8.

with the micrometer. On an average 0·4 mm. of the vertical diameter of the wire was lost in four years, so that there is still 96 per cent. of the original cross section left. On long straight sections of the trolley wire the wear is less than the average, while at the curves, owing to the lateral oscillations of the contact bar the wear is somewhat greater, amounting sometimes to as much as 1 mm. Greater wear over very short sections is often apparently due to the wire having been partially annealed at the soldered joints.

Last summer the Dresden tramway management replaced the trolley by the sliding contact on a suburban section of their line; one of the principal reasons for the change being the very satisfactory working of the sliding contact on the central sections of their system.

Herr Stobrawa hopes that these results of its working at Dresden will help to make known the many advantages of the Siemens-Halske sliding contact over the almost universally used trolley. It is a pity that the author of this very able article did not make his investigation complete by giving the relative amounts of energy dissipated by the sliding contact and the trolley wheel, due to the friction between them and the trolley wire. It has been asserted that at high speeds the energy dissipated by friction is considerably greater with the sliding contact than with the trolley. But the recent improvements introduced at Dresden may have altered this condition of things.

THE TELEPHONE INQUIRY.

(*Continued from page* 31.)

The Committee resumed its inquiry on Thursday, June 30th, Mr. Hanbury again presiding.

Sir Robert Hunter, solicitor to the Post Office, was recalled and examined by the Chairman in reference to the legal position of the Post Office with regard to the National Telephone Company in respect to the areas which had been initialled by Mr. Lamb, but which had not been confirmed in writing by the Postmaster-General.

The Witness said that, in his opinion, the National Telephone Company had no power to transact telephonic business in any area until it was specified in a deed poll executed by the Postmaster-General.

What are the words of the agreement bearing upon that point?—By Article 4 of the agreement of 1896 the company surrendered their right to carry on telephonic business, except under Article 1, are defined as "one of the areas specified in the second schedule," and "any other area which may from time to time be specified by the Postmaster-General in writing."

These areas have not been specified by the Postmaster-General in writing?—No.

And we have an undertaking that they will not be so specified until this Committee has reported?—That, I believe, was stated by Mr. Lamb.

That being the legal position, the company, under their agreement, have no right whatever to work in those initialled areas?—No, not in any areas, unless they are specified in this deed of 1896, or some such legal document executed by the Postmaster-General. The mere initialling by an officer of the National Telephone Company does not, in my opinion, amount to a specification by the Postmaster-General in writing of the area. If there was a definite letter signed by the Postmaster-General, or by someone in his name, agreeing to an area, I think it would be sufficient.

You are quite clear, at any rate, that the company would be in-

fringing the rights of the Post Office if they began to work in these merely initialled areas?—Yes. Of course I am speaking as a matter of strict law.

We have only to do with the strict law. Is any other consent required before they can work in such areas?—No. Directly the areas are specified under that article, then their rights to work in them arise.

How about the local authority?—It is not necessary that they should get any consent from the local authority as to working. The consent they have to get from the local authority is the consent to exercise the Postmaster-General's wayleave powers within that area.

They could not do much without exercising the wayleave powers, and therefore, before they begin operating in these areas, they would require the consent of the local authority?—No. I do not think you can take it in that way. They might fly a wire over the street, providing it does not interfere with the ordinary user of the street, and therefore, if they can get the consent of private persons for attachments to their houses, they can carry overhead wires through any urban district without the consent of the local authority at all.

Mr. Bartley: And in absolute defiance of the local authority?—That is a mode of expression, but you can put it in that way.

The Chairman: I understand that, in addition to getting the written consent of the Postmaster-General before they can begin to bring their service into operation, the company have to get the consent of the local authority so far as wayleaves are concerned?—Yes; if they want to take up streets, or to exercise any power, except of flying a wire at a height which does not interfere with the ordinary user of the street.

Sir J. Woodhouse: Do you know that the practice has been to act, with regard to these areas, upon the initialling of an officer of the Department?—Yes.

What would be your opinion, if it were established that these initials of the officer of the Department had been placed there by the authority of the Postmaster-General?—I think that, as a matter of strict law, that would be sufficient. We have an Act which says that an instrument may be executed by a secretary in the name of the Postmaster-General, but that is a special mode of execution, and I do not think that the initialling on a plan of those areas would be sufficient.

By Mr. Cohen: It was his opinion that the moneys of a public fund could not be used by a corporation for the purposes of telephone enterprise, except, perhaps, by the Corporation of London, which was in a singular position.

The Chairman: Assuming there was no Post Office service in Newcastle, and only the exchange of the National Company, has not the Post Office a perfect right to insist upon the National Company connecting its exchange with any trunk wire?—I should like to consider that question. It puts the matter in an awkward way.

The Chairman: You see the importance of it?

Witness: Yes. Of course, it does not represent the usual practice.

The Chairman: I do not care about the practice; I want the law. I ask you whether it is not possible for the Post Office, by putting a small exchange area just outside the area of the National Company at Newcastle to bring the two sets of subscribers into direct communication?—I will consider the point.

Sir James Russell, a former Lord Provost of Edinburgh, and member of the Town Council, stated that he had never yet met a subscriber in Edinburgh who was satisfied with the service of the National Telephone Company. The inefficiency of the service was partly due, he thought, to the want of double-wire system, partly to the want of efficient employés to attend to the switchboard, and partly to the want of proper discipline among the employés. His view of the general situation was that the present telephone service was a source of social discontent because, owing to the heavy rates charged, the poorer classes of the community were entirely excluded from its use. His ideal telephone service would be one which would put the use of the instrument at the disposal not merely of the commercial, but even of the working classes. He did not mean by that that every working man should have a telephone in his own house, but that there should be instruments all over the city to which he should have ready access. He would like to see a state of things in which the ordinary shopkeeper, in order to add to the attractions of his shop, would have a telephone there for the use of his customers and anyone who cared to enter the shop. If the municipality had the service in its own hands, the rent of the instruments would be a moderate one, and the shopkeeper would have no difficulty in recouping himself. At present a shopkeeper could not adopt this course, because the telephone company insisted upon the use of instruments being confined to subscribers. If the Edinburgh Corporation were granted a license they would be quite prepared to make the instruments open for general use. He would give shops, for instance, the same privileges as were now enjoyed by hotels in the matter of telephonic communication. They had been advised that the Corporation could provide an efficient municipal telephone service for an average of less than £5 per annum per instrument. Business houses using the instrument frequently would be charged somewhat more, and householders who used it less frequently, would be charged somewhat less than £5. The length of time for which a municipal license should run would depend a great deal upon how the license was to be terminated. If they were to hand over their undertaking before they had had a reasonable period within which to recoup the money invested, then they should expect the Government to take over their plant and give them compensation. If they had a period of 25 years, or even 21 years, in which to work the license, they would be able to repay the money invested by means of a sinking fund, without levying extra charges on the subscribers. He did not think corporations could successfully work a telephone service if their licenses had to come to an end in 1911, unless there was a distinct understanding that the Post Office would take over the plant at its then value. The Corporation of Edinburgh did not propose to make the service any charge upon the rates. It must pay its own way.

By Mr. Boscawen: They would undertake to supply everybody and to give no preferences. He did not envy the position of a popularly elected body like a town council, which gave, or proposed to give preferences.

By Mr. Bartley: The Corporation would allow subscribers the most liberal terms as to hours of service, including Sundays. It was true the Corporation did not allow tramcars to run in the streets on Sunday, but they would allow people to talk through the telephones on the Lord's day.

Mr. Nicholson, representing the Tunbridge Wells Telephone Subscribers' Committee and the local Chamber of Commerce, said the Corporation of Tunbridge Wells were anxious to have a license to work the telephone within their own boundaries. The estimate which had been submitted to them showed that they could give a more efficient service than that of the National Telephone Company at a rental per subscriber of £5 a year, including the royalty to the Post Office. An agent of the National Telephone Company had informed him that it was no use their agitating in Tunbridge Wells against the company, because the National Telephone Company were really and practically the junior partners of the Post Office. He would undertake to furnish the Committee with the name of the agent.

Mr. A. C. Morton, formerly M.P. for Peterborough, speaking on behalf of the Corporation of London, said his experience was that the National Telephone Company's service in London was not only very bad, but that it was the worst in the United Kingdom.

The Chairman: Can you speak for all the towns of the United Kingdom?—I can speak for a large number of places where I have had the opportunity of testing the service.

Do you know any special reason why it should be worse in London than it is in Manchester?—Only the reason that London has been more victimised by companies than any other part of the United Kingdom, and they seem to think they can do just as they like with London.

Is there anything in the conditions of the London streets or atmosphere, or the number of wires overhead, that makes it more difficult for the company to work in London than in Manchester?—I am afraid I am not expert enough to say, but I should not think there was anything in the atmosphere of the City of London to affect the telephone.

Continuing, Witness said in his opinion nowadays the telephone was an absolute necessity now for business, and £20 per annum was too high a price to pay for it. To a big merchant £20 was as nothing, but the telephone was not really effective unless they got the little people to use it as well as the big ones, because the big man had to do business with little men as well as with big ones. He thought that a good service ought to be had for £10. The Common Council had passed a unanimous resolution declaring that the telephonic service should be under the management and control of a public authority, and they used a term "public authority" because they had formed a definite opinion against any company's continuing to have it. He did not think the Corporation would have any objection to the County Council's being the authority at all events, they had expressed no opinion against the County Council. The County Council, however, only represented 120 square miles, the area of the metropolis, whereas the London area of the National Company was a little over 600 miles. Consequently, besides the County Council and the City, a lot of other authorities would have to be brought in, and it had been suggested, as a possible settlement, that there should be some statutory committee to manage the whole area of 600 square miles.

Mr. G. Green, an alderman of the Norwich Town Council, said that their Corporation had been anxious for some years to obtain a telephone license. The charge of the National Company at present was £8, but in a town like Norwich, the tradesmen of which were, generally speaking, in only a small way of business, this was excessive. The view of the Corporation had been, and was now, that they should have the right either to work the license themselves, or to hand it over to be worked by a responsible and accredited company under Parliamentary or municipal control. It would be a stipulation if the license was handed over to a company that it should be worked on exactly the same lines as if the Corporation were working it themselves. By handing it over to a company they would at once avoid the question which had been raised several times before the Committee of where the funds were to come from.

The Chairman: Supposing the Corporation found that the company to which the license was handed over was going to be bought up by the National Telephone Company, what action would they take?—In such a case we should deem it incumbent upon us to take steps which would prevent the initiation of such a proposal. If they refused to go on with the work they must hand back the license to the Corporation.

Mr. Nicol: You could have a provision as to forfeiture?—Yes.

The Chairman: Would you control this company as to charges?—Absolutely.

And would you compel them to supply everybody with telephonic communication?—Everybody of credit.

Everybody who could pay their subscriptions in advance?—Yes.

The Witness, in reply to other questions, said that if the difficulty of borrowing money for the purposes of telephonic enterprise were got over, he thought the Corporation of Norwich would rather incline to work the license themselves.

The Committee adjourned.

The Committee resumed its inquiry on Tuesday, Mr. Hanbury in the chair.

Mr. Lloyd, town clerk of Huddersfield, recalled, said it was common ground between the Corporation and the National Telephone Com-

pany, that the present service was not an efficient one, and it had been fully admitted in letters that had passed between the general and district managers of the company and the Corporation.

Mr. H. G. Clare, town clerk of Liverpool, said he wished to give evidence on behalf of the Liverpool Corporation and the Association of Municipal Corporations. There were certain resolutions passed by the latter body, one of which was to the effect that in the event of the Postmaster-General not taking over the telephone service it should be competent for municipal or other local bodies to undertake such service.

The Chairman: On behalf of the Liverpool Corporation, I understand that you oppose that?—Yes; the Corporation of Liverpool are now and always have been opposed to any dealing with the telephone system except as a national matter.

On what ground?—On the grounds that the telephone system ought to be treated like the telegraph system, as a national matter, and that the importance to great commercial centres of communicating not only within their own particular municipal or urban areas, but outside them, and also of communicating with other towns is so great, that the service cannot be satisfactorily supplied, unless the whole concern is under the control of one body.

Has that policy been embodied in a resolution of the Corporation?—Yes; a resolution was passed on May 20th last to that effect. Continuing, the Witness said that they would rather prefer the existing company to a municipality. He did not concede the point that the National Telephone Company must exist until 1911—he thought that satisfactory arrangements might be come to between the company and the Government, by which the latter would take over the telephone service of the entire country. The Post Office had already acquired the trunk lines at a price of 10 per cent. beyond what they cost, and having done that he failed to see why there should be any great obstacles in the way of their acquiring the remainder of the system.

Is the telephone service in Liverpool efficient at the present time?—I think the telephone service in Liverpool is as good as one could reasonably expect from any company working under the conditions that the National Telephone Company have been, but we are going, I hope, to very largely improve it under an agreement which the Corporation have made with the National Telephone Company, which in consideration of the Corporation allowing them to place its wires underground, is going to convert the whole of the single wire system in Liverpool into a metallic circuit. All the wires that can possibly be laid underground are to be laid in tubes in subways so that when once the work is done there will be no further taking up of the streets. In order to protect the public as much as we could we have got an agreement that the company shall not raise their existing charges, and that they shall be forced to supply all the people in Liverpool who wish it under the same conditions. That is to say, that they shall abolish what I may call undue preferences. The agreement further provides that the company shall pay to the Corporation a reasonable rent for the use of the streets; that all street work shall be done absolutely to the satisfaction of the Corporation; that the maintenance of the streets shall be borne by the company for a period of six months after they have been broken up, and there is a further provision that in the event of the company reducing the present prices to subscribers in any city or area, otherwise than those in the Metropolitan area, below those at present in operation in Liverpool, that then they shall bring down the charges in Liverpool.

What is the present price in Liverpool?—£10 for the first connection, and £8 10s. for the second and subsequent connections.

Are there any conditions attaching to that price—such as taking the telephone for a term of years?—I think they do ask subscribers to sign for five years before the company will undertake to spend the capital outlay necessary to put him on the exchange, but at the same time I must say I have never heard of any difficulty being experienced by anyone wishing to get a connection. Continuing, the Witness said he did not think anyone who wanted the telephone would object to taking it for five years. He was in hopes that by the end of the present year they would have a complete metallic circuit in Liverpool, and then the inconveniences and annoyances which must inevitably arise from the present single overhead wire system would be done away with.

You said that part of the agreement entered into between the Corporation of Liverpool and the National Telephone Company was that they should abolish undue preferences; do they exist to any considerable extent?—I do not think so. The words were put into the agreement because, in our view, that is a condition which ought to be imposed upon every company that has any concession granted it for the supply of any service of this character. That was one of the points that I raised at the very commencement of this telephone agitation in 1892.

As regards your own streets and wayleaves in Liverpool, have you any complaint to make as to the existing law?—Not at all. Replying further to the chairman, the Witness said that if it were desired to have a twin-wire system properly constructed and worked it must be placed underground, and it did not make any difference to the public whether the streets were broken up by the municipality or by the National Telephone Company. He was of opinion that the Post Office never intended that there should be serious competition with the National Company, because if competition was to be effective it was absolutely essential that there should be cross connections between the subscribers of the competing companies. If the Postmaster-General, therefore, could not compete with the National Telepone Company it was perfectly absurd to suppose that municipalities could do so. In Liverpool there were 14 subscribers to the Post Office telephone, and they were big firms who wanted to get on the trunk lines.

What is the present number of subscribers to the National Telephone Company in Liverpool?—I think the number is nearly 10,000, and about 5,000 of them are within the City boundaries. Continuing, the Witness said the population of the telephone area of Liverpool was between 850,000 and 900,000. Competition was absolutely impossible under the agreement of 1896. If they could conceive Liverpool starting to-morrow to build up a municipal telephone, it would take at least two or three years to do it, and whilst they were building it up, and until they had got at least 5,000 or 6,000 subscribers, hardly anybody would come to them, for the simple reason that they would prefer to pay £8 10s., and be put in communication with the whole area, rather than pay £6 10s. to be put in connection with the few people who were subscribers within the municipal area. The effect of the Corporation attempting to build up a municipal telephone in opposition to the National Telephone Company which now existed would simply mean that for two or three years the Corporation would get no income at all, and all the time they would be spending capital on which no interest would be forthcoming. And then supposing they saw their way to reducing their charges by £2 per subscriber, he was afraid the National Telephone Company would do the same. Speaking from practical experience, he did not believe that 10 per cent. of the ratepayers in Liverpool would subscribe to the telephone even if the charge was reduced to one-half the present amount. In Liverpool 81 per cent. of the total number of assessments were under £30 a year, and it was not reasonable to suppose that many of that class of people would be found willing to subscribe to the telephone; they simply had no use for it. The telephone was of importance to commercial men, and to such the question of an extra £1 or £2 for the charge was a very small matter. What they required was a better telephone system—one that was developed more than the present in the matter of trunk lines, &c. If they could get it cheaper so much the better; but let them have a better service, and the cost did not so much matter.

Your idea is that the trunk system of telephones wants developing more than perhaps the connection between town and town?—Yes, we could do with a very large increase of trunk wires. We want several more trunk lines between London and Liverpool.

For the purpose of telephonic communication between the Liverpool area, do you think there is anything wanting to develop that?—I think the company are doing their very best to make the present system a good one by laying down this double wire system. I have been told that they are expending £150,000 over the work.

You don't think that the telephone is likely to be of general benefit?—Not in the sense that it is of benefit to a large proportion of the population, because I cannot conceive than any large proportion of the population will ever use the telephone.

You are aware of the large use made of it abroad?—I have heard of several towns abroad where the telephone is said to be used a great deal, but I don't know the conditions of those towns, and whether they are comparable to English towns.

Mr. Bartley: Don't you think if the facilities were increased and the charges reduced the number of subscribers would increase?—I don't think it would make very much difference. Almost every business man in Liverpool has the telephone in his office, for which he pays £10 a year, and he can have a connection with his private residence for another £8 10s. Continuing, the Witness said that if the telephone were made cheaper and more efficient there might be some extension of its use, but he felt certain that there would be no reduction in price if the municipality worked a competitive system. He came to that conclusion because, for one thing, a company working for a profit could get its labour cheaper than a municipal body which was subject to periodic elections. Therefore, he did not think there would be any saving in working expenses so far as the employment of operators, &c., were concerned, in fact, he should rather say that there would be a tendency to increase the charges by the payment of higher wages. That being the case he did not see how it would be possible for a municipality to work an independent telephone service in competition with the National Company at a cheaper rate. So far as he could calculate from the National Company's accounts, about 55 per cent. of their gross revenue was absorbed in working expenses, which was exclusive of the 10 per cent. royalty paid to the Government, which practically made the expenses 65 per cent. The telephone charge in Liverpool was £10, but after deducting the royalty the company only got £9. According to Mr. Preece's evidence before the last committee the initial cost of building up a telephone service was about £40 a subscriber, and on those figures he did not see how the Corporation could possibly make the thing pay. After they had paid their expenses and provided the money for the sinking fund, there would be very little difference indeed in the prices at which they could supply the service and the present charges of the National Company. Of course his conclusions would be somewhat modified if Mr. Preece had reduced his estimate, but at present he was not aware that he had done so.

You think that the Liverpool Corporation is quite unable to compete in these matters with a private company?—The Corporation do not think it desirable to enter into such a competition, and personally, I think it impossible for them to compete successfully. Liverpool owned and worked its tramways, electric light, and waterworks. The electric light paid well. They had reduced the price to the consumer from 7d. to 5d. per unit, and made a profit of £28,000.

Do you see any difference between the Corporation undertaking the supply of the telephone and of the electric light?—Certainly; for in the electric light we have no competitors, but in telephones we should.

Replying to Mr. Cawley, the Witness said that the Corporation paid about £1,600 a year for the use of telephones. His own opinion was that the small tradesman would not take the telephone, even if he could get it for £5.

By Sir James Woodhouse: Supposing they could get the service for £5 per annum, he did not believe it would result in doubling the present number of subscribers in Liverpool He did not admit, however, that the telephone could ever be worked at that figure. The

Government ought to be able to work the system more economically than anyone, and they would probably be able not only to improve the service, but to reduce the charges. He felt very strongly that that was the ultimate solution of the matter, therefore he opposed the granting of licenses to municipalities, because it would make it much more difficult for the Government to get control of the system as a whole at some time or other. His view was, that they ought not to municipalise anything which was not of benefit to the large majority of the ratepayers.

Mr. Harrison, Town Clerk of Leeds, stated that his Corporation had entered into a similar agreement with the National Telephone Company as that described by the last witness. He did not see a very great difference between municipalities supplying the electric light and telephones. There was, however, this difference, that the electric light was, as a rule, confined to the municipal area, while the telephone service was one that went far beyond the city boundaries. The telephone service was of importance to the whole community, and should therefore be dealt with from a national point of view and managed by the State. He agreed with the last witness that should the Government at any time decide to take over the whole system, the matter would be very much complicated if various municipalities had systems of their own. In the absence of State purchase, however, and given an area where there would be no competition by the National Telephone Company, he did not see any objection to the municipality undertaking the telephone service.

Answering Sir J. Woodhouse, the Witness said he could not say that Leeds was absolutely satisfied with the present system. They did not regard it as perfect, but he did not think there were so many complaints in regard to it as there used to be. The Parliamentary Committee of the Leeds Corporation had passed a resolution approving of the resolutions passed by the Association of Municipal Corporations, including the one referred to by the last witness as to the desirability of municipalities undertaking the telephone service in the event of the Postmaster-General refusing to do so.

The Chairman: Then you are in favour of municipalisation?

The Witness: Yes, failing the taking over of the telephones by the Government.

The Committee then adjourned.

SOME NOTES ON THE PRACTICAL USE OF SINGLE-PHASE ALTERNATING MOTORS.

By E. E. HOADLEY, Chief Assistant Engineer, Worcester Corporation.

At the present time there are two facts which are very gradually forcing themselves home in the minds of that portion of the British public interested in the supply and use of electricity for power purposes. These facts are:—(1) That by far the larger proportion of central stations, existing and contemplated, supply a single-phase alternating current. (2) That it is both practicable and convenient to use such a current for driving machinery by means of motors.

It is still a matter of the greatest difficulty to persuade either the owner of a large factory, taking, perhaps, several 100 H.P., or a man with two or three small machines, that an installation of motor driving is anything more than a costly experiment, in which the chances of failure are about 10 to 1; yet this question is one that our Continental competitors in the world's markets have settled for themselves some time ago, and have reaped a considerable benefit by a liberal use of electrically driven machinery.

My friend, Mr. Eborall, has already, through the medium of your columns, admirably explained the construction and good and bad points of most of the alternating motors at present on the market, so I will confine myself to a few facts about their behaviour under actual working conditions.

Here, in Worcester, a town in no ways celebrated for its go-ahead policy, the single-phase current is more used for motor work than in any other town in England, excepting London. The central station was laid down in 1894, and is somewhat remarkable from the fact that it is one of the few stations in England where water-power is used. The water-power, however, is only an auxiliary, as, although the maximum load on the station is about 330 kw., 120 kw. is the most that can be done by the water-power under the most favourable conditions.

The current is generated at a pressure of 2,000 volts, with a periodicity of 100 per second, which is not an ideal frequency for motor work; it is distributed at a pressure of 100 volts.

There are at present on the circuits motors representing an aggregate of between 90 and 100 B.H.P., while another motor of 12 H.P. will be connected up in the course of a few weeks. They are in use for widely-differing purposes, including the following:—At the Corporation Waterworks the pumping for the high level parts of the town is done by two motors, each of 30 H.P., made by the Oerlikon Company, of Zurich, Switzerland, driving by means of belts three-throw horizontal pumps; a factory for the manufacture of tins, including those used by Messrs. Wills for their tobacco, and by the Platinotype Company for their photographic paper, is partly driven by a 6-H.P. motor, also of the Oerlikon Company's manufacture. It would be difficult to imagine a more arduous condition of service for an electro-motor than driving a row of tin stamps, the load being continually and almost instantaneously varied from something over full load down to a very small fraction of this. Yet so successfully has the motor done its work, that the owners are now installing another motor of 12 H.P. to drive another set of stamps.

There are a number of other motors, varying in size from 3 H.P. down to $\frac{1}{10}$ H.P. being used for nearly every purpose for which motors can be used, such as driving fans, coffee grinders, barbers' brushes, cartridge-filling machines, machines for tearing flock and combing hair in an upholsterer's factory, and many others.

An 8-H.P. motor was some few months ago put in to partly drive a printing works, the motor working on the same line of shafting as a gas engine of about 6 H.P. This state of affairs was hardly satisfactory, and caused a good deal of trouble and inconvenience to the owners of the works. The reasons for this trouble were probably the following:—firstly, the motor was a synchronous one, and, as such, could only run at one fixed speed, consequently, when running with the gas engine on the same shaft, would tend to keep the speed constant whatever the load, until it was loaded past its critical point and ran out of step; as machine after machine was thrown into gear, the speed of the gas engine would tend to drop slightly under the increased load, but this would mean that the speed of the line of shafting would be diminished too; this, however, could not occur, as the speed of the motor could not alter; consequently the motor took up more and more of the load until it ran out and stopped, and it could not be started up again without throwing the machines out of gear. Not only was the sudden stoppage a great nuisance, but the overload the motor would take before running out caused much over-heating, and would in time ruin the insulation.

The second reason was, that when starting up the motor, a transformer action took place between the windings on the field poles; and between the windings on the two adjacent poles forming the ends of the field circuits, there existed a momentary E.M.F. of somewhere about 4,000 volts, which, as the windings were almost touching, was very likely to break down the insulation and spark across; this, indeed, occurred on two occasions, necessitating rewinding the poles and causing serious stoppages.

Notwithstanding all these disasters, so convinced were the owners of the factory of the benefits of electric driving, that, instead of immediately turning round and saying hard things against everything electrical, they only ordered a motor of a non-synchronous type of the Langdon-Davies make, which is working very satisfactorily, and has only one disadvantage, that being, that it has to be started up on a loose pulley, whereas the synchronous motor would start under a good proportion of its rated output, and did not take an excessive current to do so.

As I am looking at this question of the use of alternating motors from the point of view of a central station engineer, perhaps a few words on the charges to be made for the power supplied to them and their effect on the lighting will be of interest.

First, as to the charges; there are many central stations nowadays where an equitable system of charging for all energy consumed is in force. There are two systems which are quite sound, either the well-known and largely adopted one propounded by Mr. Arthur Wright, of Brighton, and called after him, the Wright or Brighton System, and the one proposed by Dr. John Hopkinson, and in use at Manchester, Hammersmith, and other places. The principle is the same in both, and is this—that anything that demands or may demand a supply of electricity during the hours of maximum load, shall bear its proper proportion of the standing charges; in the first method this is obtained by charging

for all electricity consumed up to a one or two hours' daily use of the maximum demand at a high price, and all used in excess of this at a price slightly above the running costs; in the second method by a fixed charge per quarter per kilowatt demanded, and a price per unit just covering the generating expenses.

For motors which are in use during the hours of heavy load, this is a just and equitable arrangement, and as they are generally in use for a good many hours per day, the average price per unit comes out fairly low, more nearly approximating the lower figure the greater number of hours they are in use per day. But in cases where motors are only used, or likely to be used, during the hours of light load, such as in the early hours of the morning, or in the daytime, before the lighting load begins to come on, a very much lower charge can be made, one just sufficient to cover the running expenses, as there are no standing charges to be met, because the plant would only remain idle were there no motors.

In Worcester we have a good example of this, the two 30-H.P. motors at the waterworks are only run during the hours of light load, and consequently the electricity supplied to them is only charged at the very low rate of 1½d. a unit; and absurd as it may appear on the face of it, there is a profit, though small, to be earned at this price. Some people may say that we can afford to sell it at this price at Worcester as our water-power costs us nothing, and it is this that we use chiefly during the hours of light load; but I maintain that any entirely steam-driven station can afford to sell electricity, when used under similar conditions at a price equal to, or very slightly above, 1½d. per unit.

The price per unit charged to motors which are in use over the period of maximum load, which is just before 5 p.m. in winter here, was fixed before the demand system was brought out, and is on the sliding-scale principle, by which motors using up to

			Not exceeding	1,000	units per quarter,	3d.	per unit.
Over	1,000	"	"	2,000	"	2½d.	"
"	2,000	"	"	5,000	"	2d.	"
			Over	5,000	"	1½d.	"

and for motors which do not use as many units as a one-hour's daily use of their maximum demand, 6d. per unit. A few figures with regard to the waterworks motors may be of interest. They are actual figures got from personal observation, or extracted from the books of the Corporation.

No. 1.—One motor running for 9 hours 30 minutes.
Energy consumed, 168 B.O.T. units.
95,000 gallons pumped 300 feet.

No. 2.—One motor running for 6 hours 45 minutes.
Energy consumed, 212 B.O.T. units.
67,500 gallons pumped 300 feet.

No. 3.—One motor working 11 hours 45 minutes.
Energy consumed, 212 B.O.T. units.
117,500 gallons pumped 300 feet.

Average.—18 B.O.T. units used per hour = 18,000 watts.

Apparent watts = 12 amperes × 2,000 volts = 24,000 watts.

$$\frac{18}{24} = \cdot 75 = \text{power factor.}$$

From this we see that there is another slight disadvantage in the use of alternating motors, especially if running light, the power factor being so low, the alternator is overloaded before the engine has full load on, thus increasing the capital cost per kilowatt laid down, for to obtain anything like the full output of the engine the windings of the alternator would be dangerously overheated. The power factor at Worcester varies between ·5 and ·98, the former figure when there are several motors running underloaded and practically no incandescent load on, and the latter during full load in the evening when there are no motors on.

With regard to the efficiency of these motors, it may be generally taken that 1 H.P. can be got for every 1,000 actual watts supplied to the motor. This is rather low for the larger motors which have an efficiency of 83 or 84 per cent. at full load, but is correct for motors of about 5 to 8 H.P.

The total efficiency of conversion of the waterworks pumping plant may be of interest, so I will give a set of figures, which are taken haphazard, and are nothing like the best that could be got.

10,000 gallons raised 300 feet in 1 hour.

$$= \frac{10{,}000 \times 10 \times 300}{60} \text{ foot lbs. per minute.}$$

$$= \frac{10{,}000 \times 10 \times 300}{60 \times 33{,}000} = 15{\cdot}15 \text{ H.P.}$$

$$18 \text{ units per hour} = \frac{18 \times 1{,}000}{746} = 24{\cdot}1 \text{ E.H.P.}$$

$$\frac{15{\cdot}15}{24{\cdot}1} = \text{a total efficiency of } 66{\cdot}5 \text{ per cent.}$$

which, considering the two facts that the motor was not running at its most efficient load, and that the pumps are by no means the best of their kind, is an extremely satisfactory result.

From these figures we get that to lift 10,000 gallons per hour a height of 300 feet costs 2s. 3d.

Or that an actual H.P. (as measured by the water lifted) costs 1·8d. per hour at 1½d. per unit.

Another bugbear to the use of alternating current motors which has at various times been put forward by their opponents is, that their use will very seriously interfere with the evenness of pressure so necessary for good incandescent lighting.

My own experience has led me to the conclusion that, under certain conditions, there is some truth in this statement, though I am of opinion that the difficulties arising in this direction are far from insurmountable.

With alternators having a very drooping characteristic, as nearly all alternators with iron in their armatures have, this is a somewhat serious matter. The "blink" on the lights caused by the sudden switching on of an induction or other alternating motor may be said to have two component causes; firstly, owing to the momentary variation of speed produced by the sudden increase of load; in badly governed engines this decrease of speed may be more than momentary, though with an engine having plenty of fly-wheel effort combined with good governing, and with our increasing experience with such effects in engines used for tramway work, this should soon become a thing of the past; then there is the other reason, the rush of current, a good deal out of phase, through the alternator armature, reacts on and distorts the field, and, as it were, dams back the magnetic lines; this is a more serious obstacle and very difficult to overcome.

I have seen a 6 H.P. induction motor switched on, which caused a most pronounced "blink" on the lights, even though a 125 kw. alternator was supplying the bus bars at the time, and every care was taken both in switching on the motor and having a switchboard attendant and engine driver standing ready. I ought to say, however, that the generator was running with very little load on at the time. The little 1 H.P. motors used for running Ferranti rectifiers, under certain conditions, cause a regular pulsation on the lights, noticeable, though faint, as they are running up to speed, especially when nearing synchronism, the pulsations on the lamps being synchronous with the "beats." This effect was noticed when the rectifier motors were supplied with current from iron-cored alternators, and although the flickering could be detected by a practised eye when looked for, yet it was nothing very objectionable, and was not observed over the whole system of supply, but only in or very near the station.

With machines having no iron in their armatures, as the Mordey alternators at Worcester, a 30 H.P. motor can be put on without any perceptible variation in the lights, unless the machine has almost no lighting load on at the time, when a slight drop is apparent; as I have already stated, the control of the waterworks motors is in the hands of the engineer-in-charge, for the men at the waterworks are not allowed to stop or start a motor without instructions by telephone from the lighting station. The 30 H.P. motor, which is started on a loose pulley, takes a starting current of from 16 to 18 primary amperes, which current is, of course, a great deal out of phase with the volts; this soon drops to 8 or 9, and as the pumps are opened out, rises to about 12, which is the normal working current.

The motors are started up by the stoker or labourer on duty at the waterworks, and once started, need no attendance, skilled or otherwise: for as soon as they are started, the door of the motor house is locked, and the stoker goes back to his fires. The care with which the motors are started makes all

the difference, whether it is noticeable on the lights or not; if a man cuts out all his starting resistance with one turn of the switch, there is bound to be a momentary jump, but with ordinary care there is nothing to be seen, even if one looks for a jump.

The other motors of 8 H.P. and downwards cause no inconvenience of any kind; the larger ones have regular hours of running, and beyond the fact that the switchboard attendant alters his regulator slightly when they come on or go off, no notice is taken of them.

I think I have now said enough to show that the case of interference with the supply of light is not so strong as has sometimes been put forward, and that what difficulties do exist are neither very great, or ones that cannot, with increasing knowledge and experience, be overcome.

By the above facts, I think I have proved that in at least one town in England the problem of the use of single-phase alternating motors has been tackled with a fair amount of success; and I venture to predict that when it is more widely known that, under certain conditions, the use of motors of this type is a success both commercially and technically, and with the improvements which are now being made in these motors, and with our seeming reluctance in this country to take up two or three-phase working, central station engineers will be able to add to their day load very considerably, in the course of the next year or two, by the use, for many and various purposes, of single-phase alternating motors.

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. Thompson & Co.**, *Electrical Patent Agents,* **322,** *High Holborn, London, W.C., to whom all inquiries should be addressed.*

13,666. "Improvements relating to electrical fuses." W. Clark. Dated June 20th.

13,680. "Improvements in secondary electric batteries or accumulators." S. W. Hart and E. J. Clark. Dated June 20th.

13,682. "Improvements in electric incandescent lamps." V. Saglier and E. de Marcay. Dated June 20th. (*Complete.*)

13,687. "Improvements in electric arc furnaces." P. C. Day and The Acetylene Illuminating Company, Limited. Dated June 20th.

13,702. "Improvements in dynamo-electric machines and electric motors." H. F. Joel, jun. Dated June 20th.

13,707. "Improved electro-acoustic telegraph with Morse transmitter." N. Flechtenmacher. Dated June 20th. (*Complete.*)

13,709. "Improvements in or relating to the electric propulsion of railway trains." O. H. E. Kasselowsky. Dated June 20th. (*Complete.*)

13,721. "Improvements in suspended electroliers." J. G. S. Cunnungton. Dated June 20th. (*Complete.*)

13,765. "Improvements in quadruplex and multiplex telegraphy and to apparatus for use in connection therewith." S. G. Brown. Dated June 21st.

13,769. "Employment and useful application of the electric force to aerostat and balloons of all kinds." M. Vasseur. Dated June 21st.

13,781. "Improvements in automatic electric block signal systems for railways." L. C. Werner. Dated June 21st. (*Complete.*)

13,793. "Improvements in electric generators." E. Edwards. (P. A. Emanuel, United States.) Dated June 21st. (*Complete.*)

13,827. "Improvements in speed varying devices and electric motors for use therein." R. Belfield. (R. H. Hassler, United States.) Dated June 21st.

13,833. "Sub-station equipment fuse box." T. Rooke and W. H. Grimsdale. Dated June 22nd.

13,861. "Improvements in and connected with the electro-deposition of copper and other metals on rotary cathodes." W. E. Heys. (E. Dumoulin, France.) Dated June 22nd. (*Complete.*)

13,882. "Improvements in apparatus employed in wireless telegraphy." G. Marconi. Dated June 22nd.

13,895. "Method of reducing the energy of magnetisation of electrical transformers when the output is small." Siemens Brothers & Co., Limited. (Siemens & Halske, Aktien Gesellschaft.) Dated June 22nd. (*Complete.*)

13,942. "Combined standard and portable electric light." F. Thomson. Dated June 23rd.

13,943. "Improvemements in the filaments of electric incandescent lamps." W. A. Coates and R. L. Wood. Dated June 23rd.

13,946. "A new and improved electric connection and coupling." W. H. Hunt. Dated June 23rd.

13,951. "Improvements in metallic tubular conductors for protecting electric wires and cables." G. M. Stewart. Dated June 23rd.

13,960. "Electrode for accumulators." H. Damm. Dated June 23rd. (*Complete.*)

13,969. "Improvements in trembler interrupters for electric currents." A. Wydis and O. Rochefort. Dated June 23rd.

13,999. "Improvements in and appertaining to electric stop motions employed in machinery or apparatus for elongating or drawing strands of cotton and other fibres." Dated June 24th.

14,007. "Improvements in apparatus for working wireless telegraphy." R. Kennedy. Dated June 24th.

14,012. "Improvements in electric light fittings." H. C. Broan. Dated June 24th.

14,021. "Portable electric tool holders and tools." A. Benham Dated June 24th.

14,045. "Improvements in receivers for use in hydro-electric operations and other purposes."

14,058. "Improved means for operating electric railways by a combination of alternating and continuous currents." C. Pollak. Dated June 25th.

14,059. "Improvements in apparatus for producing radiation by electricity." C. H. Stearn and C. F. Topham. Dated June 25th.

14,090. "Improvements in a means of lowering the load of cranes or hoists driven by electro-motors." F. H. Royce and E. A. Claremont. Dated June 25th. (*Complete.*)

14,101. "Improvements in surface contact railway systems." The British Thomson-Houston Co., Ltd. (W. B. Potter, United States.) Dated June 25th. (*Complete.*)

14,107. "Improvements in prepayment electricity meters." F. M. Long and E. Schattner. Dated June 25th. (*Complete.*)

14,112. "Improvements in or connected with primary batteries." A. Peters. Dated June 25th.

14,113. "Improvements in or connected with the distribution of electricity by alternating currents." H. A. Wagner. Dated June 25th.

14,124. "Improvements in the construction of drums or reels for electric and other cables." W. B. Vroan. Dated June 25th.

14,132. "Improvements in and relating to electrical furnaces more particularly applicable for the production of calcium carbide." W. L. Durban and J. Gore. Dated June 25th.

ELECTRICAL PATENTS OF 1884, EXPIRING IN JULY, 1898.

We are informed by Messrs. W. P. Thompson & Co. that about 80 applications for electrical patents were filed in the month of July, 1884. Out of these applications some were never completed, and of those that were only one has been maintained to run its full length of term, viz., 14 years, and being of considerable interest we give a short abstract of it below.

10,720. "Improvements in and means for the manufacture of rollers for printing, embossing, or impressing paper, textile fabrics, and like materials." F. E. Elmore. Dated July 29th, 1884. Relates to moulds for the surfaces of printing and embossing rollers. The rollers are formed by electro-deposition upon the inner surface of a hollow metallic cylinder. This cylinder is built up in rings which are composed of semi-circular or segmental pieces bolted together by flanges. To ensure the accurate fitting of the parts, longitudinal and and circular V pieces, with adjacent V grooves are formed upon them. The cylinder is accurately turned, and a suitable gutta-percha or other pattern fixed by means of wax or cement upon the parts of the cylindrical surface which are to be in intaglio upon the roller obtained. The pattern is coated with plumbago or bronze powder, and the metallic parts greased to prevent the adhesion of the deposit, when it is hung in a depositing solution and connected to one pole of a suitable source of current, the outer surface being waxed to prevent deposition of metal anywhere but upon the interior. The cylinder is hung by a hooked bolt which passes through holes in lugs upon the end flanges. When the deposit is of the required thickness, the portions of the cylinder are taken from around it, and it is backed up and fixed to a spindle for use in the machine. 1 claim.